

US Army Corps of Engineers

Los Angeles District

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SANTA ANA RIVER BASIN, CALIFORNIA

AD-A204 543



Design Memorandum No. 1

SELECTE FEB 0 3 1989

PHASE II GDM ON THE SANTA ANA RIVER MAINSTEM including Santiago Creek

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VOLUME 3 LOWER SANTA ANA RIVER APPENDIXES

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LOWER SANTA ANA RIVER PHASE II GENERAL DESIGN MEMORANDUM APPENDIX A

GEOTECHNICAL APPENDIX

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U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

AUGUST 1988

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January 1980 September 1983 December 1985 January 1986

I. INTRODUCTION

Purpose and Scope

1-01 Geotechnical investigations were conducted to determine and evaluate the topography, geology, and groundwater and foundation conditions of the Lower Santa Ana River. This appendix provides a description of the project area; the geology, faulting and seismicity; groundwater conditions; describes the geotechnical explorations and testing performed; presents the existing foundation conditions; and parameters used in the project design. Recommendations are given for foundation treatment, embankment design, subdrainage systems, disposal site compatibility, and construction applications.

Location

1-02 The channelization measures for the Lower Santa Ana River discussed in this report extend approximately 23 miles through the northwestern portion of Orange County, California. The project begins at Weir Canyon Road and ends at the Pacific Ocean between Huntington and Newport Beaches. Localized improvements are also proposed within Santa Ana Canyon, immediately below Prado Dam. The proposed project is shown on plate 1. All Lower Santa Ana River stationing within this report is based upon the Phase I GDM alignment, as shown in table A. The Santa Ana Canyon stationing will not be adjusted.

Description of Existing Condition

1-03 Channelization of the Lower Santa Ana River, from Weir Canyon Road to the Pacific Ocean, currently consists of several types. Typical channel sections are described in the following paragraphs. The reaches are defined by the existing geometry and structures. A tabulation of designed and existing conditions along the Lower Santa Ana River is shown in table 1. Typical existing cross-sections from the original construction drawings are shown on plate 2.

Table A. Lower Santa Ana River.

Phase I-Phase II Stationing
Equation Table

Landmark	Phase I Station (as used in this appendix)	Phase II Station
Weir Canyon Road	1202+00	1207+10
Imperial Highway	1057+50	1055+50
Lakeview Avenue	975+50	983+48
Riverside Freeway	918+50	926+28
Santa Fe Railroad	890+00	897+80
Lincoln Avenue	813+50	821+50
Ball Road	742+00	749+30
Katella Avenue	701+00	708+92
Orange Freeway	675+00	682+45
Santa Ana Freeway	617+50	625+40
Garden Grove Freeway	595+00	603+17
Santiago Creek	558+50	566+00
17th Street	513+50	521+30
Edinger Avenue	385+00	392+80
Harbor Boulevard	342+00	349+90
San Diego Freeway	254+34	262+20
Adams Avenue	163+71	171+32
Fairview Channel	145+00	150+32
Hamilton-Victoria	82+16	90+40
Pacific Coast Highway	9+47	17+20

WEIR CANYON ROAD TO KATELLA AVENUE

1-04 From Weir Canyon Road downstream to a point about 1100 feet south of Katella Avenue, a distance of 9.5 miles, the existing channel is trapezoidal in cross section with a soft bottcm invert and stone revetted side slopes of 1V on 2H, extending to a depth of 9 feet below invert. It has a base width ranging from 300 feet at the upstream end to 320 feet near Katella Avenue, and levee heights ranging from 12 to 14 feet. Below Imperial Highway, to Katella Avenue, a series of water retention basins exist which parallel the river outside the right levee. The water elevation in these basins is controlled by weirs and is retained at an elevation approximately level with that of the adjacent river invert. Within this reach there is one invert stabilizer and eight drop structures.

KATELLA AVENUE TO GARDEN GROVE FREEWAY

1-05 Downstream from Katella Avenue to the Garden Grove Freeway, a channel reach of 2.1 miles, the earth-bottom trapezoidal channel has a base width varying between 240 to 270 feet, a levee height ranging from 12 to 16 feet, and side slopes changing from 1V on 1.5H to 1V on 3H. The upper 500 feet of channel with the steeper side slopes has concrete slope protection, and the remaining reach of this channel has flatter stone-revetted slopes, extending to a depth of 9 feet below invert. Within this reach of channel, two drop structures, approximately one mile apart, were constructed by the Orange County Flood Control District. There are also two invert stabilizers.

GARDEN GROVE FREEWAY TO 17TH STREET

1-06 For a distance of 1.5 miles, from south of the Garden Grove Freeway to the vicinity of north of 17th Street, the river has only limited improvement. About half of the banks are protected by pipe and wire fence, and the remaining banks within the River View Golf Course are stabilized by turf. One drop structure has been constructed at the southern end of this reach.

17TH STREET TO ADAMS AVENUE

1-07 From approximately 1200 feet upstream of 17th Street to about 3000 feet downsteam of Adams Avenue, a reach of 7.4 miles, the channel is well entrenched with a soft bottom, trapezoidal cross section, and levee heights ranging from 13 to 17 feet. The side slopes, varying from 1V on 1.5H to 1V on 2H, are protected with reinforced concrete, which extends 8 feet below invert. The base width of the channel varies significantly within this reach, ranging from 180 to 230 feet. Since 1980, seven invert stabilizers have been constructed within this reach.

ADAMS AVENUE TO PACIFIC OCEAN

1-08 Downstream from Adams Avenue for a distance of 1.8 miles, the base width of the soft-bottom trapezoidal channel varies from 230 to 160 feet. The channel height varies from approximately 16 to 18 feet. The side slopes of the channel are 1V on 1.5H and are protected with reinforced concrete, which extends to 4 feet below invert. A riprap toe protection continues to a depth of 7 feet below invert.

1-09 From the above reach to the Pacific Coast Highway, the distance is 0.6 miles. The channel base width is 160 feet except at the downstream 0.2 miles where the width changes to 180 feet and the soft-bottom channel changes in cross section from trapezoidal to rectangular. The wall height for both types of channel sections is approximately 16 feet. The vertical channel walls are constructed with reinforced concrete. The invert is concrete paved.

1-10 The outlet of the Santa Ana River is located south of the Pacific Coast Highway in Huntington Beach where the river enters the Pacific Ocean. The outlet consists of a transition section, from rectangular to trapezoidal, with a stone jetty containment. The 700-feet long channel reach has a soft bottom invert with a base width that increases from 180 to 316 feet, as the Greenville-Banning and Huntington Beach channels converge with the Santa Ana River at the mouth.

SANTA ANA CANYON

1-11 This portion of the Santa Ana River is located just below Prado Dam in an area that has limited development and minor floodproof improvements, by locals, scattered throughout this reach. The entrenched river meanders through the 9-mile long canyon with a base width ranging from 250 feet at the drop structure to approximately 100 feet in the Green River Golf Course area. At the drop structure, there is an approximately 8 feet change in elevation of the river with the surrounding terrain being typical of flood plain areas. At the Green River Golf Course, the river flows under the Santa Fe railroad bridge and continues on through the golf course in a well defined path flowing under several foot and golf cart bridges. The surrounding floodplain area (golf course) is a well kept grass with many mature trees and shrubs.

Description of Proposed Improvements

1-12 The Lower Santa Ana River improvements vary according to the parameters of hydraulic capacity, right-of-way constraints, and geotechnical conditions. For the purpose of geotechnical analyses, seven reaches of the river have been identified as having distinguishing characteristics. The proposed project is described in the following subparagraphs in terms of the unique geometric conditions of each particular reach. See plate 3 for proposed typical cross sections of each reach. The geotechnical conditions within these reaches will be discussed in subsequent paragraphs. A summary of the future flow conditions, including the design flow of 30,000 cfs, is presented below:

All River Plan - Future Flow Conditions

Q - cfs	2000	5000	10,000	20,000	30,000	
Days Exceeding Q in 100 years	3490	1512	655	201	10	

WEIR CANYON ROAD TO IMPERIAL HIGHWAY, (REACH 1; Main Report-Sta. 1207+10 to 1055+50; This Appendix-Sta. 1202+00 to 1057+50).

1-13 Along this 3-mile reach the existing cross-section of channel will be utilized to the extent practical. Two new drop structures will be constructed between Weir Canyon Road and Imperial Highway to supplement the existing one, with four stabilizers added between the drop structures. Material between invert structures will be removed and the result will be that the invert level will be about 5 feet lower. The new levee crest will be about the same or up to 4 feet higher than the existing, depending on the location. The levee slopes will be revetted with grouted stone.

1-14 As the levee height is increased on the south side of the river upstream from Imperial Highway, the levees will be built upward and outward into the existing river channel. The close proximity of the Riverside Freeway on the south side makes it impractical to encroach into the freeway right-of-way. In order to obtain a usable channel base width of between 290 and 300 feet it will be necessary to rebuild about 2-1/2 miles of the existing north levee. The channel centerline would be shifted about 20 feet northward. A transition will bring the channel back to the existing centerline just upstream of the Imperial Highway bridge.

IMPERIAL HIGHWAY TO KATELLA AVENUE, (REACH 2; Main Report-Sta. 1055+50 to 708+92; This Appendix-Sta. 1057+50 to 701+00).

1-15 Improvements in this 7-mile reach will consist of upgrading the existing trapezoidal earth-bottom channel. To provide greater channel capacity, levee heights will generally remain at the existing height, but will be raised up to 3 feet, depending on location with respect to drop structures. Typically, the channel side slopes will be revetted with grouted stone. Approximately 1 mile of channel slopes, however, will be covered with riprap. The rock toe revetment will be extended to a lower elevation. The seven existing drop structures will be hydraulically redesigned. Twelve new invert stabilizers will be located within this reach. The spreading basins adjacent to the flood control channel will remain. At bridge crossings, a minor amount of work will be necessary; for example, access ramps above and below the bridges will be provided or restored as necessary. Ramp work will be designed by the County.

KATELLA AVENUE TO SANTIAGO CREEK, (REACH 3; Main Report-Sta. 708+92 to 566+00; This Appendix-Sta. 701+00 to 558+50).

1-16 In the 3-mile reach of river from south of Katella Avenue downstream to the Garden Grove Freeway, the channel will be trapezoidal with a soft bottom. The existing channel base width narrows from about 320 feet upstream of Katella Avenue to 270 feet downstream. Rather than widen the channel, the levee crest levels will be raised about 3 to 5 feet. The channel will continue with about a 270-foot base width and an average 16-foot depth, to the confluence with Santiago Creek. The

revetment will be strengthened by the uses of approximately 1 mile of grouted stone slope protection, and a generally larger riprap size. There are three new drop structures and five new stabilizers in this reach.

SANTIAGO CREEK TO 17TH STREET, (REACH 4; Main Report-Sta. 556+00 to 521+30; This Appendix-Sta. 558+50 to 513+50).

1-17 At the Santiago Creek confluence, the east revetment will bend around to the north bank of the creek and stop about 200 feet upstream. On the west side of the river, a grouted stone slope will continue to a transition into a concrete channel about 700 feet upstream from 17th Street. A grouted stone drop structure will be constructed immediately upstream from the Santiago Creek confluence.

17TH STREET TO FAIRVIEW CHANNEL, (REACH 5; Main Report-Sta. 521+30 to 150+32; This Appendix-Sta. 513+50 to 145+00).

- 1-18 This 7-mile reach of channel currently has concrete side slopes extending about 8 feet below the existing soft bottom invert. To gain more capacity, the recommended plan calls for conversion to a paved, hard bottom channel.
- 1-19 In the reach from 17th Street down to about the San Diego Freeway, the top width of channel would be about the same as the existing top width, in the range of 242 to 250 feet. The slopes and invert would be paved. The channel will be about 18 feet deep.
- 1-20 South of Edinger Avenue, the river is no longer deeply entrenched. The levees rise to about 12 feet above the natural ground line, with the river bottom only about 3 feet below the ground line. The river bottom will be lowered an average of about 5 feet in order to increase channel capacity.
- 1-21 In the reach from the San Diego Freeway down to the Fairview channel, the top (and base) width of channel would be about the same as the existing top width, but within this reach the channel would be converted to a rectangular, hard-bottom channel.
- 1-22 Near Adams Avenue, the channel gradient flattens from 9 feet per mile to about 3 feet per mile. At this point the concrete channel will widen from 250 to 365 feet, and the wall heights will increase from about 18 to 21 feet to accommodate the slower flow. To avoid additional right-of-way requirements along the east side of the Greenville-Banning channel near Adams Avenue, the Santa Ana and Greenville-Banning channels will be located very close to one another. Thirty feet of clearance will be maintained between the two channels to provide for an elevated access road. Ramps constructed along the reach will provide access into the concrete channel. At several bridges, tunnel underpasses will be constructed to retain grade-separated crossings. Several bridges will be rebuilt or modified. All bridge, tunnel and ramp improvements will be designed by the County.

FAIRVIEW CHANNEL TO HAMILTON-VICTORIA STREET, (REACH 6; Main Report-Sta. 150+32 to 90+40; This Appendix-Sta. 145+00 to 82+16).

1-23 The Santa Ana River will transition and widen to 450 feet in the area adjacent to the Greenville-Banning channel confluence with the Fairview channel. The main channel will transition from concrete to soft bottom with revetted slopes. A soft bottom (approximately 8 feet lower than the existing) is required in this tidal zone of the Santa Ana River for environmental reasons. The Greenville-Banning channel will parallel the Santa Ana River as a concrete bottom channel.

HAMILTON AVENUE-VICTORIA STREET TO THE PACIFIC OCEAN, (REACH 7); Main Report-Sta. 90+40 to End; This Appendix-Sta. 82+16 to End).

1-24 The Santa Ana River and Greenville-Banning channels will be merged into one common soft bottom channel just below the Hamilton Avenue-Victoria Street Bridge. The Santa Ana River and Greenville-Banning combined channel will be about 22 feet deep and 480 feet wide. The channel bottom will be lowered to 10 feet. The revetted channel slopes will continue to within 500 feet of the ocean; at that point, the channel walls will transition to stone jetties that extend to the low tide line.

SANTA ANA CANYON

1-25 The Corps of Engineers will construct localized improvements in the canyon reach, to supplement existing improvements by others. The proposed Corps improvement at the existing drop structure (below Hwy. 71) will consist of extending a 23 foot deep steel sheet pile wall on both sides. The sheet piles will extend 45 degrees back from ends of the drop structure, for a length of 100 feet, to prevent eddy current erosion.

1-26 The proposed Corps improvement at the Green River Golf Course area will consist of a levee along the south side of the river to protect an existing mobile home park. The upstream portion of the levee will tie into the existing Santa Fe bridge abutment and the dowstream end will tie into the Riverside Freeway (State Highway 91). The levee will be approximately 4 feet higher than the existing ground surface and the riprap slope protection will extends downward at a 1V on 2H slope approximately 40 feet to provide protection below the river's thalweg.

MATERIAL DISPOSAL

1-27 During construction of the river channel, an estimated 4.5 million cubic yards of material will be excavated from the channel bed. Some of the required excavation will be used for channel improvement. The excess material, which naturally would be deposited in the ocean by floodflows, may be placed on neighboring beaches between Anaheim Bay and Newport Bay if it is deemed suitable for such use. Additional inland disposal sites have been identified, by utilizing existing landfill operation and depleted gravel mining sites. The inland disposal sites are discussed in the environmental appendix.

II. GEOLOGY

Topography

2-01 The Lower Santa Ana River project is situated within the southeastern (Orange County) part of the Los Angeles basin (see fig. 1), a broad alluviated lowland plain on the coast of southern California at the north end of the Peninsular Ranges province. The physiographic basin is bounded on the east and southeast by the Santa Ana Mountains and San Joaquin Hills and on the northwest and north by the Santa Monica Mountains and the Elysian, Reppetto, Puente and Chino Hills of the Transverse Ranges province. Elevations in the rolling hills to mountainous terrain that rim the coastal plain range from 200 feet to more than 5000 feet above sea level.

2-02 The Santa Ana River has its headwaters in the San Bernardino Mountains and flows across the Upper Santa Ana Valley to Prado Dam. Downstream from Prado Dam, the Santa Ana River flows through the relatively narrow steep-sided Santa Ana Canyon for a distance of approximately 9 miles. The north side of the canyon is bounded by the rolling topography of the Chino Hills (also known as the eastern Puente Hills). On the south side, the more rugged, higher, and more geologically diverse Santa Ana Mountains bound the canyon. Downstream from Santa Ana Canyon, the river flows across the Los Angeles basin, also referred to as the central plain in figure 2. The river flows through a coastal lowland known as the Santa Ana Gap before entering the Pacific Ocean. The gap is an alluvial valley about 2-1/2 miles wide, bounded on either side by highland areas known as the Huntington Beach and Newport Mesas. The mesas range in elevation from about 50 to 85 feet higher than adjoining areas in the gap.

Regional Geology

2-03 The Los Angeles basin is underlain by a northwest trending structural depression (see fig. 2), parts of which have been the site of discontinuous deposition since late Cretaceous time and of continuous

subsidence and deposition since late Tertiary time (Yerkes and others, 1965). The Precambrian to Cretaceous age igneous and metamorphic basement rocks are overlain, in the deepest part of the basin, by approximately 30,000 feet of chiefly marine sediments ranging in age from Cretaceous to Holocene (Recent). Locally around the margins of the basin, particularly in the Santa Ana Mountains, these sediments have been stripped away by erosion to reveal the complex assemblage of basement rocks. A geologic map of the project area is shown on plate 4.

2-04 The Los Angeles basin in late Tertiary time extended well beyond its present day margins. However, tectonic forces subsequently produced several smaller depositional basins including the San Fernando, San Gabriel and Upper Santa Ana inland valleys. The rapidly rising mountains bordering the basin as well as changes in the sea level began to affect the cycle of erosion and deposition. As a result, up to several thousand feet of alluvial sediments derived from the surrounding highland areas were deposited in the ever deepening basins during the Pleistocene; a process which continues even today.

2-05 Near the mouth of the Santa Ana River, at the Santa Ana Gap, the geologic conditions are further complicated by deformation and uplift along the Newport-Inglewood structural zone. As a result of this deformation, early Pleistocene formations are exposed in mesas on either side of the river. The gap itself was created near the end of the Pleistocene when a major decline in sea level occurred. The ancestral Santa Ana River, in response to this changing base level, eroded a valley, the Santa Ana Gap, about 200 feet deep across the elevated coastal plain. After the last of the ice age glaciers melted and the sea level began to rise, the river began to aggrade, depositing coarse alluvium (the Talbert aquifer). As the rate of sea level rise slowed, the sediments became finer grained. These relatively impervious silts. clays, and organic deposits effectively confined the very permeable sands and gravels below. Generally speaking, these finer grained deposits are present from the Pacific Ocean to just below the confluence of the Santa Ana River and Santiago Creek. As a result, the Los Angeles basin in Orange County is hydrologically divided into two main subbasins (see fig. 3), the Santa Ana Forebay, which occurs generally north of the Santa Ana Freeway and is characterized by unconfined groundwater and the Santa Ana Pressure Area, which lies south of the freeway and is characterized by confined groundwater (California Department of Water Resources, 1959).

Local Geology

GENERAL

2-06 The Los Angeles basin contains a thick succession of Late Cretaceous through Pleistocene marine and nonmarine clastic sedimentary rocks and interbedded volcanic rocks of middle Miocene age. This assemblage overlies rocks of the Jurassic to Late Creteceous-age basement complex. Regional stratigraphic studies infer that, in the

central part of the basin, the lower parts of this succession are thinned or missing beneath younger rocks; the Pliocene and Quaternary strata are as much as four times as thick as in the Santa Ana Mountains; and the entire depositional sequence attains a maximum thickness of about 30,000 feet (Yerkes and others, 1965). The basement complex includes the Bedford Canyon Formation, the Santiago Peak Volcanics, and intrusive plutonic rocks of the southern California batholith.

COASTAL PLAIN

2-07 The lowest sedimentary rocks overlying the basement complex consist of up to approximately 10,000 feet of predominantly sandstone and conglomerate of Late Cretaceous to early Miocene age. These rocks are overlain by up to several thousand feet of middle and upper Miocene marine sandstones, siltstones, and conglomerates assigned to the Topanga and Puente Formations. Locally, thick sequences of Miocene age intrusive and extrusive igneous rocks occur in several parts of the basin. Rocks of Miocene age are overlain by about 2000 feet of lithologically similar marine sediments of the early Pliocene lower member of the Fernando Formation. The upper member of the Fernando Formation, locally called the Pico Formation, follows in stratigraphic sequence, and consists of up to 5000 feet of Late Pliocene age marine sediments, similar in composition to those of the lower member. Pleistocene marine and nonmarine deposits range in thickness from about 200 to 2500 feet. They are divided into the San Pedro Formation of early Pleistocene age, unnamed middle Pleistocene deposits, and the La Habra Formation of Late Pleistocene age. In the Santa Ana Gap, the entire upper Pleistocene section, which ranges in thickness from 0 to 400 feet, has been designated the Lakewood Formation by the California Department of Water Resources (1961). Sediments of Holocene (Recent) age consist of alluvial and littoral deposits of clay, silt, sand, gravel, and peat. In the Santa Ana Gap, the Recent unit has been divided into upper and lower zones. Fine sand, silt, and clay of low permeability form the upper zone above the permeable coarse sands and gravels of the lower zone. These deposits range in thickness from 0 to a maximum of 180 feet in the Santa Ana Gap.

SANTA AMA CANYON

2-08 The Santa Ana Canyon is approximately 9 miles long and only 0.3 miles wide at the narrowest place, just below Prado Dam. The Quaternary alluvial fill in the canyon has a nearly uniform thickness of from 80 feet near the upper end to 100 feet in the lower part. The alluvial deposits are coarsest at depth, where boulders from 1 to 2 feet in diameter are present. The deposits are predominantly sandy near the surface. The bedrock floor beneath the streambed alluvium is deeper above the head of the canyon and below its mouth. Remnants of alluvial material deposited by the Santa Ana River at elevations now above the active stream channel are present as terraces on both sides of Santa Ana Canyon. Bedrock exposures in the mountains and hills which border the canyon consist generally of marine and nonmarine sandstones, siltstones, and conglomerates of Late Cretaceous to Pleistocene age. Rocks of the

older basement complex, consisting of Santiago Peak Volcanics and related intrusive rocks, outcrop near the upper end of the canyon in the Santa Ana Mountains.

GEOLOGIC STRUCTURE

2-09 The depth to the basement surface along the Santa Ana River is influenced by several northwest-trending structural features, the major ones being a doubly plunging synclinal trough underlying the central part of the basin and an anticlinal feature known as the Anaheim nose (see fig. 2). Depths to basement rock range from about 14,000 to 16,000 feet below sea level in the Santa Ana Gap area, rising gently to an average subsea depth of 9500 feet in the axial part of the Anaheim nose. The northeast flank of the anticline slopes down to an average subsea depth of about 12,000 feet in the lower portion of the Santa Ana Canyon area. Depths to basement rock are much shallower in the upper reaches of the canyon, where they have been complicated by faulting.

Faulting

GENERAL

2-10 The Lower Santa Ana River. like most locations in southern California, is surrounded by active or historically active faults capable of generating earthquakes which could cause seismic shaking along the river. The most significant of these faults are listed in table 2 along with the magnitudes of maximum probable and maximum credible earthquakes, and postulated maximum horizontal accelerations in rock attenuated to the nearest limits of the project. The maximum credible earthquake (MCE), as defined by the U.S. Army Corps of Engineers (1983b), is the earthquake(s) associated with specific seismotectonic structures, source areas, or provinces that would cause the most severe vibratory ground motion or foundation dislocation capable of being produced at the site under the currently known tectonic framework. It is determined by judgement based on all known regional and local geological and seismological data. The maximum probable earthquake (MPE), however, is the earthquake that by probabilistic determination of recurrence could occur during the design life of the project. The major structural features within a 100-mile radius of the project area are shown on plate 5. The Lower Santa Ana River improvements between Prado Dam and the Pacific Ocean are in close proximity to or actually cross three main separate zones of faulting (see pl. 4), which are discussed in the following paragraphs.

WHITTIER PAULT ZONE

2-11 At the upstream end, the Whittier fault zone lies approximately 1 mile north and 0.5 miles south of the Weir Canyon Road and Green River Golf Course improvements, respectively. The Whittier fault zone, which consists of northwest trending sub-parallel branching and en echelon faults, extends from Whittier Narrows in Los Angeles County to Santa Ana

Canyon, a distance of about 25 miles, where it merges with the Elsinore fault zone, and continues through the Peninsular Ranges to the Gulf of California. As stated previously, lateral and vertical movement along the Whittier fault, since the late Tertiary, is at least partially responsible for the formation of the Chino Hills. Recent fault investigations along the trace of the fault have uncovered offsets in Holocene age alluvium (Dames and Moore, 1980). In addition, both micro and macro seismicity in the area suggest that the Whittier fault is active (Dames and Moore, 1980).

2-12 North of the Whittier fault zone lie two subsidiary west-trending faults, the Scully Hill and the Aliso Canyon faults (see pl. 4). The projected trace of the Scully Hill fault crosses the alluvial fill of the Santa Ana Canyon about 1200 feet north of the proposed Green River Golf Course improvements while the inferred trace of the Aliso Canyon fault is just below Prado Dam and less than 100 feet south of the Prado Dam outlet channel drop structure. These faults may be associated with either the Whittier or Elsinore fault zones, but they do not appear to be direct extensions or splays of either (Woodward-Clyde Consultants, 1980). The activity of these two faults is not known but apparently unfaulted Quaternary-age terrace deposits have been mapped across the Scully Hill fault in the Horseshoe Bend area of Santa Ana Canyon (Durham and Yerkes, 1964).

EL MODEMO-PERALTA HILLS FAULTS

2-13 Approximately 7 miles downstream of Weir Canyon Road, near Lincoln Avenue, the river crosses a poorly defined zone of possible concealed faulting, which might be a projection of either the Peralta Hills or El Modeno faults. The Peralta Hills fault, an east-trending, north-dipping thrust fault, has a mapped surface trace of more than 5 miles along the southern side of the Peralta Hills. The El Modeno fault is a northwest-trending, steeply-dipping normal fault which extends along the southwestern flank of the Santa Ana Mountains. fault trace segments lie separated by short expanses of alluvial materials but may in fact be connected into a continuous and discrete feature (Ryan and others, 1982). There is some evidence suggesting that both the El Modeno and Peralta Hills faults may displace Holocene (Recent) alluvium (Morton and others, 1976; Bryant and Fife, 1982; Ryan and others, 1982), including a possible groundwater barrier as evidenced by a significant differential in static water levels between key wells downstream from well no. 4S/9W-6P01 and upstream from well no. 4S/9W-8C01 (see pl. 6). The trace of the northern portion of the El Modeno fault has not been precisely located. Its trend may lie parallel to that of the Peralta Hills as shown on plate 4, or the fault, as Bryant and Fife (1982) suggest, may be truncated by or pass beneath the Peralta Hills fault.

HEWPORT-INGLEWOOD FAULT ZONE

2-14 The Newport-Inglewood fault zone, which extends from possibly Baja California to at least Santa Monica in Los Angeles County (a distance of approximately 150 miles), is the predominant structural/tectonic feature

to cross the Santa Ana River. The zone is approximately 4 miles wide near the mouth of the river (Santa Ana Gap). It is characterized by northwest trending parallel faults and folds. Within the Gap (downstream of the San Diego Freeway), three primary branch faults within the Newport-Inglewood fault zone have been mapped (see pl. 4). These branches are referred to as the South Branch fault, the North Branch fault, and the Bolsa-Fairview fault. The location and extent of the numerous individual faults in the gap area are predominantly defined in the subsurface from oil well data and groundwater barriers in the older basin sediments. Geologic evidence of surface faulting within the fault zone is minimal. Guptill and Heath (1981) reported that possible evidence of surface faulting on the North Branch of the Newport-Inglewood fault zone at Newport Mesa may be associated with the 1933 Long Beach earthquake. A study by Woodward-Clyde Consultants (1984) demonstrated that near-surface faulting on the Newport-Inglewood North Branch fault at Huntington Beach Mesa may be late Pleistocene or possibly Holocene in age. No evidence of surface faulting on these branches has been documented within the Santa Ana Gap. Despite the fact that there is little or no indication of direct shearing or displacement in the main body of the Recent sediments extending across the fault zone, the zone is seismically active as evidenced by the 1933 Long Beach earthquake, as well as subsequent macroseismic activity (Barrows, 1974).

Seismicity

HISTORIC SEISMICITY

2-15 The Lower Santa Ana River is located in Zone 4 of the Seismic Zone Map of the Contiguous States (U.S. Army Corps of Engineers, 1983a), an area of high seismic potential. The California Institute of Technology's seismologic data base for southern California, Nevada, and Arizona indicates a total of 592 earthquakes with Richter magnitudes equal to or greater than 4.0 have occurred within a 100-mile radius of the project area between February 1932 and January 1987. A plot of their epicenter locations, including magnitude 6.0 or greater events since 1900, are shown on plate 5. The most significant earthquakes (Richter magnitudes of 6.0 or greater) to occur within a 100-mile radius of the project area and their likely fault sources are listed in table 3. Earthquakes which could cause shaking along the river range from a major event on the San Andreas fault zone (approximately 30 miles northeast of the project area at its closest extent) to shaking and possible ground rupture from a near-field event on the Newport-Inglewood fault zone at the lower end of the project. The California Institute of Technology's 55-year computer record lists 165 earthquakes as having occurred within a 25-mile radius of the project area. The majority (150) of the events had Richter magnitudes between 4.0 and 4.9. Fourteen earthquakes had assigned magnitudes between 5.0 and 5.9, while the 1933 Long Beach event, with a Richter magnitude of 6.3 was the largest instrumentally recorded event in the area. However, the rate of seismicity has not been uniform throughout this period. Approximately 90 percent of these shocks occurred during the first 10 years of the record. Much of this

seismicity can be attributed to the 1933 Long Beach earthquake and aftershock sequence. Between January 1962 and January 1987, only six events, none with a magnitude greater than 4.5, occurred locally. The October 1, 1987 Whittier Narrows earthquake, with a Richter magnitude of 5.9 and an epicenter location a minimum of 19 miles northwest of the Santa Ana River, was the largest instrumentally recorded earthquake to occur near the project area since the 1933 Long Beach event.

FAULT ZONE SEISMIC PARAMETERS

- 2-16 The historical record, although brief, indicates that potentially damaging earthquakes have occurred, and, given the developed pattern of seismic activity, would be expected to occur during the design life of the project. Using the attenuation curves for horizontal accelerations in rock developed by Schnabel and Seed (1973) and Greensfelder (1974), a maximum credible earthquake of Richter magnitude 7.0 generated on the Newport-Inglewood fault zone near the mouth of the Santa Ana River would produce a maximum rock acceleration of approximately 0.7 g at that location. However, a maximum probable earthquake with a Richter magnitude of 6.0 would result in a lower maximum rock acceleration of slightly less than 0.6 g at the epicenter location. Similar rock accelerations could be produced at the upstream end of the project by a local maximum credible or maximum probable event on the Whittier-Elsinore fault system. Horizontal bedrock accelerations resulting from the recent (1987) Whittier Narrows earthquake were recorded by instrumentation at three Corps of Engineers' dams near the project area. Peak accelerations of 0.16 g and 0.22 g were recorded by the respective left abutment accelerometers at Brea Dam, located 5 miles northwest of the Santa Ana River and 14 miles southeast of the earthquake epicenter, and at Carbon Canyon Dam, located 9 miles north of the river and 17 miles southeast of the epicenter. A peak acceleration of 0.07 g was recorded at the left abutment of the more distant Prado Dam (28 miles from the earthquake epicenter). The magnitude 5.9 earthquake produced an estimated maximum rock acceleration of less than 0.15 g along the middle portion of reach 2 of the channel. However, no damage to any existing structures along the Lower Santa Ana River was reported.
- 2-17 Considerable uncertainty exists as to the tectonic significance of the Peralta Hills and El Modeno faults. Both faults may be capable of producing large-magnitude earthquakes (probably in the Richter magnitude 5.5 to 6.0 range). However, the Peralta Hills fault could represent only a surficial flexural-slip reverse fault which is related to the regional tectonics but is incapable of generating a large magnitude earthquake.
- 2-18 Despite the possibility of a magnitude 8-plus event on the San Andreas fault, attenuation of ground motions would produce a maximum acceleration in rock of only 0.25 g at the upstream limit of the project. A relationship between maximum accelerations on rock and on various soil conditions was developed by Seed and others (1976). Given a maximum acceleration in rock of 0.2 g, the maximum ground accelerations

developed on various alluvial deposits would range from approximately 0.15 to 0.2 g. However, for a higher rock acceleration of 0.5 g, acceleration values for soil would be more variable, ranging from approximately 0.25 to 0.45 g. In most cases, except when maximum accelerations in rock fall below 0.1 g, the highest values for alluvium are in stiff soil conditions.

2-19 Lamar, Merifield and Proctor (1973) have estimated point recurrence intervals for both the southern segment of the San Andreas fault system and the Whittier-Elsinore fault system. For magnitude 6 and 7 events on the Whittier-Elsinore system, recurrence intervals of 300 and 2000 years, respectively, have been estimated. In contrast, a magnitude 8 earthquake on the San Andreas fault has a much shorter recurrence interval, estimated to be about 200 years. Little information is available on recurrence intervals for the Newport-Inglewood fault zone. Woodward-Clyde Consultants (1983) estimated a return period of approximately 200 years for a large earthquake (magnitude 7.0).

POTENTIAL SEISMIC HAZARDS

2-20 In the historic past, the 1933 Long Beach earthquake with a Richter magnitude of 6.3 probably caused the greatest shaking along the Lower Santa Ana River (see pl. 4 for epicenter location). The Long Beach earthquake resulted in numerous surface expressions other than ground rupture. These included surface cracking due to lurching and settling, landslides and/or rockfalls, changes in water table elevations in wells and structural damage due to liquefaction, settling, or lurching. Disruption of the ground surface, not necessarily along known faults, will probably occur during any future event of the magnitude and duration of the Long Beach earthquake (Barrows, 1974). Cracking of the ground might cause damage to the project during any large magnitude shocks. In addition, elevation changes resulting from possible earthquake induced subsidence and uplift may also occur.

2-21 Rapid tectonic subsidence and/or uplift in the project area would most likely be associated with a major seismic event (magnitude greater than 6) on the Newport-Inglewood or Whittier-Elsinore fault zones. Elevation changes resulting from events with magnitudes less than 6 would be more localized and probably not measurable (Morton and others, 1976). Leveling surveys bracketing the Long Beach earthquake showed possible earthquake induced subsidence of as much as 0.4 feet and apparent uplift of as much as 0.6 feet in portions of the southern coastal plain area (Morton and others, 1976).

Groundwater

BASIN DESCRIPTION

2-22 The Lower Santa Ana River lies within the Orange County groundwater basin (see fig. 3) which includes the Santa Ana Gap area. The water-bearing sediments in the basin consist of Quaternary and some

late Tertiary alluvial deposits. In general, at least three distinct bodies of groundwater have been identified in the project area (Poland and others, 1956). They are: (1) a "semiperched" or shallow zone of water of variable chemical quality that occurs in the upper part of the Recent alluvium; (2) a zone of fresh groundwater or deeper zone that occurs in the lower part of the Recent alluvium as well as in Pleistocene and older units, and (3) a body of saline groundwater that underlies the fresh-water body and occurs in sediments of Tertiary age. The most important aquifer in the Recent alluvial deposits are the Talbert sands and gravels which extend from the lower end of Santa Ana Canyon to the Pacific Ocean. The Talbert aquifer has an average thickness of approximately 70 feet, and generally occurs above elevation -200 feet below sea level. The most important source of groundwater in the Pleistocene age sediments, underlying the Recent alluvium is the Main aquifer within the San Pedro Formation. This aquifer generally occurs at elevations between -500 and -200 feet below sea level and also tends to be continuous across the basin.

2-23 The groundwater basin is replenished naturally and artificially in the area generally north of the Santa Ana Freeway. To the south, groundwater occurs under artesian pressure in aquifers which are interbedded with sediments of low permeability. Thus percolation of surface waters to the aquifers in the pressure area is greatly restricted. The upper "semiperched" zone is essentially unconfined, and, according to Robbins (1986), regionally extensive rather than being composed of isolated discontinuous lenses. An evaluation of various types of groundwater data, including gradient directions, elevation of water levels, and water quality suggests an interrelation (i.e., hydraulic continuity) between the upper shallow zone and the deeper aquifers in the forebay area. The shallow zone generally occurs above a depth of 50 feet in the Recent deposits.

2-24 The Newport-Inglewood fault zone forms a more or less effective barrier to groundwater movement to and from the Pacific Ocean in sediments underlying the Recent deposits in the Santa Ana Gap area. These formations have been tilted and extensively faulted so that barriers to hydrologic continuity have been created and the saline ocean water cannot directly intrude them. Groundwater, however, appears to move in an unrestricted manner within the Recent sediments across the fault zone.

GROUNDWATER LEVELS

2-25 Groundwater information for the Lower Santa Ana River was obtained from Orange County Water District (OCWD) groundwater contour maps (OCWD, 1987), state water well records compiled by the California Department of Water Resources, and Robbins (1986). A November 1986 groundwater contour map of the Orange County groundwater basin is shown in figure 4. Water well data available for the project were used to develop piezometric groundwater profiles along the river which are shown on plate 6. The highest and lowest recorded groundwater elevations are depicted for key wells in the vicinity of the river. In addition, three

generalized water level profiles, two derived from OCWD November 1984 and November 1986 groundwater contour maps and one derived from a November 1984 shallow groundwater contour map by Robbins (1986) are shown. The upper 1984 profile represents the approximate level of the shallow zone while the lower 1984 profile and the 1986 profile are composites of water levels from the various deeper fresh water aquifers. In general, water levels along the Lower Santa Ana River tend to undergo monthly and seasonal fluctuations, primarily in response to the seasonal and cyclic unbalance between groundwater replenishment and draft. Examination of individual state well records indicates that water table elevations have varied considerably since the 1920's. Net changes range from as little as 10 feet to more than 150 feet. Recent though limited well data available for the project reach between Adams Avenue and Lincoln Avenue indicate that in 1985 seasonal variations in groundwater levels of between 4 and 15 feet occurred. In general, the highest water levels were measured during the winter and spring (February and May) while the lowest water levels were recorded in the summer and fall (August and November).

2-26 Upstream of the Santa Fe Railroad bridge, and in Santa Ana Canyon, the water table is fairly shallow because of the relatively thin alluvial cover. In the upper reaches of Santa Ana Canyon, between the Green River Golf Course and the Prado Dam drop structure, groundwater is generally present at an average depth of 20 feet outside the channel thalweg. A water table elevation of 435 feet was established for the Prado Dam outlet channel drop structure area as a result of field investigations by the Corps of Engineers in 1987. Water well data available for that reach of the canyon downstream of Prado Dam covering the proposed Green River Golf Course channel improvements indicate that the groundwater table in 1966-68 ranged from elevation 435 feet approximately 2 miles upstream from the golf course to elevation 417 feet near the golf course. Water levels were at their highest (5 to 6 feet above current levels) in this reach during 1939-40, prior to construction of Prado Dam, and only minor fluctuations, up to a maximum of about 15 feet, have been recorded since then. In the vicinity of Weir Canyon Road, the groundwater was at depths ranging from 15 to 18 feet (elevation 312 feet) in August 1982. In 1984, water levels recorded in wells just upstream of Weir Canyon Road near the Savi Ranch levee, showed similar depths to groundwater but with an average groundwater table elevation of 320 feet. In November 1986, water levels ranged from approximately 20 feet (elevation 240 feet) near Imperial Highway to approximately 35 feet (elevation 200 feet) near the Riverside Freeway.

2-27 As the river emerges from the canyon onto the coastal plain and the depth to bedrock increases, water levels in the deep aquifers decline sharply, to depths exceeding 100 feet. Plate 6 indicates a maximum depth to groundwater in November 1986 of about 135 feet (elevation +60 feet) near well 45/10W-7M01 (upstream of Lincoln Avenue). This rather anomalous steep gradient may indicate the existence of a possible fault related groundwater barrier (see paragraph 2-13). Downstream of Lincoln Avenue, water levels, despite some extreme fluctuations due to local recharge conditions (see November 1984 deeper

zone groundwater profile), become progressively shallower towards the ocean as the ground surface elevation decreases. Near the coast, the water table elevation tends to be at or near sea level (see pl. 6), fluctuating with the amount of natural and artificial recharge and pumping. This lower reach is also affected by the Newport-Inglewood fault zone. Between 1977 and 1985, there has been an overall rise in deeper groundwater levels throughout most of the basin, ranging from 10 feet in state well 6S/10W-5BO3, between Adams Avenue and the San Diego Freeway, to 30 feet in well 4S/10W-25FO1, near Orangewood Avenue. Information on water level trends in the shallow zone is not available but if the upper zone does mimic the deeper groundwater flow regime as Robbins (1986) suggests, then similar upward trends might be expected although the magnitude of such changes would probably be much less.

2-28 The "semiperched" shallow zone, as depicted on plate 6, generally occurs above a depth of 50 feet, and also becomes progressively shallower towards the ocean. Downstream of 17th Street, water levels in this upper zone are typically within 25 feet of the existing channel ground surface. A comparison of the differences in elevation between the shallow zone and deeper zone water levels by Robbins (1986) reveals that elevation differences on the order of 40 to 60 feet are common for most of the basin while in the northern portion of the basin (near Santa Ana Canyon) and near the coast, differences are minor and the two zones in a sense merge together. The Orange County Water District (1981) monitored the semiperched groundwater zone as part of their Green Acres Project study. Three observation wells, located near the river channel between 5th Street and the San Diego Freeway, encountered water at depths ranging from 27 feet (approximate elevation, 48 feet) in the upstream well to 9 feet (approximate elevation, 11 feet) in the downstream well.

2-29 Water levels encountered during subsurface explorations by the Corps of Engineers, along the Lower Santa Ana River alignment (see pls. 8 through 26), generally do not reflect the regional groundwater conditions previously described but instead are indicative of a localized zone of influent seepage (a mounded condition) which exists because of perennial low flows in the channel. However, downstream of the San Diego Freeway where groundwater levels are fairly shallow, there is good correlation between the depths to water in subsurface borings and the local groundwater conditions.

CONSTRUCTION CONSIDERATIONS

2-30 A review of published groundwater information available for the Lower Santa Ana River project indicates that the regional groundwater table will probably be encountered during construction in at least two reaches of the channel: (1) upstream from Lakeview Avenue (sta. 975+50) and (2) downstream from the San Diego Freeway (sta. 254+34). However, the localized mound of subsurface water, generally present at depths between 1 and 5 feet in the active river channel, will be encountered throughout the construction reach. Both shallow groundwater and mounded subsurface water would require implementation of a dewatering scheme prior to construction. Diversion and control of the perennial surface flows in the river channel will also need to be addressed during

construction. In addition, tidal variations within the lower reach of the project downstream of Adams Avenue (sta. 163+71) will create additional dewatering requirements. Groundwater conditions within the project area will continue to be monitored in the future to detect any possible changes which might affect channel design or construction.

SEA WATER INTRUSION

- 2-31 The Talbert and older Pleistocene aquifers are very productive and have yielded great quantities of water since the early 1900's. By 1930, the pumping of groundwater had lowered pressure levels in the shallow aquifers to below sea level and sea water intrusion began. See plate 7 for a piezometric profile of the Talbert aquifer in 1963. Since the Talbert aquifer was in continuity with the ocean it was the first to experience the effects. By 1960, the intrusion had also begun to affect certain water bearing zones below the Talbert aquifer.
- 2-32 The problem of sea water intrusion in the Santa Ana Gap and methods to prevent it were studied in detail by the California Department of Water Resources (1966). One of the suggested plans to control intrusion was to create an injection ridge along Ellis Avenue. This plan was later implemented by construction of the Talbert Barrier Project, which maintains a seaward hydraulic gradient in the underlying aquifers by the injection of potable water under pressure. The barrier project, which consists of a water supply, a distribution pipeline, a series of closely spaced injection wells, extraction wells, and numerous monitoring wells, was completed in 1975 and water was first injected in 1976. This plan has been successful in reversing the gradient and halting the intrusion of saline water. Plate 7 shows a recent piezometric profile and contour map of the gap. As a part of the injection program, the Orange County Water District monitors a series of wells, see plate 7, on a weekly, monthly, and biannual basis. In addition to the piezometric levels in the aquifer, various water quality parameters are measured and the results published in a Talbert Barrier Performance Report.
- 2-33 In 1979, ten shallow soil borings were drilled by the Corps of Engineers with a hollow stem auger between Hamilton Avenue and the Pacific Coast Highway along the existing Santa Ana River channel. The generalized information from these borings in addition to data from previously drilled observation wells and shallow soils investigations conducted along the Santa Ana River channel by various geotechnical firms are presented in cross-section on plate 7. The top of the Talbert aquifer is positively identified in the deeper observation wells at an elevation between -40 and -70 feet below sea level. Downstream from well M-10 the top of the aquifer is not positively known. However, it may daylight at sea level near the Pacific Coast Highway. Regardless, excavations for a soft bottom channel in this reach would not affect the quality of the groundwater because the Talbert aquifer is already in hydrologic continuity with the ocean and the injection program upstream maintains a positive gradient which would not allow landward movement of degraded water.

Subsidence

2-34 Only minimal land subsidence has been reported in the immediate vicinity of the Lower Santa Ana River even though significant amounts of both oil and water have been extracted from the subsurface. Morton and Miller (1976) indicate that the only measureable subsidence (up to 0.15 feet) occurred along the river south of Warner Avenue between the leveling surveys of 1964-65 and 1968-69-70. However, a maximum of 5 feet of subsidence due primarily to petroleum withdrawal has been estimated for the period 1920 to 1972 in the vicinity of Huntington Beach (Morton and Miller, 1976). Very localized subsidence due to possible soil consolidation or oxidation of peat layers caused by lower groundwater levels has also been reported to have occurred in scattered inland areas from Sunset to Newport Beaches (Leighton-Yen and Associates, 1974). Subsidence due to petroleum withdrawal has been stabilized by water injection and little additional effect due to soil consolidation or peat oxidation is expected.

III. INVESTIGATION

General

3-01 Information on conditions of the foundation, levee, invert, and sources of borrow along the approximately 23 miles of river alignment has been collected from several sources. Previous investigations conducted for the County of Orange by various geotechnical firms supplement recent investigations by the Corps of Engineers. The investigation techniques included hollow stem and bucket auger borings, and backhoe trenching. Both disturbed bulk samples and undisturbed tube samples were obtained for testing. All test site excavations were logged. The logs of the Corps of Engineers' investigations are presented on sheets immediately following each plan of investigation plate. The logs of investigation conducted for the County of Orange are presented on sheets following the Corps of Engineers' logs and the appropriate plan of investigation plate. See plates 8 through 27 for the plans, profiles, and logs of the investigation. The investigation methods and sites are discussed in subsequent paragraphs, in relation to the location and structural feature of the proposed improvements. The individual locations of test sites may be utilized for the assessment of more than one feature and, in those cases, those sites are mentioned several times.

Existing Levees and Foundation

PREVIOUS INVESTIGATION

3-02 The existing levee system along the Lower Santa Ana River has been the subject of many subsurface investigations. The specific investigations are referenced in tables 4 and 5. The logs of the levee investigations by others (for the County of Orange) are reproductions from the original reports and are shown on plates 8 through 26.

RECENT FIELD INVESTIGATIONS

3-03 A levee foundation and embankment investigation was conducted by the Corps of Engineers, over a period of several years. In 1979, 10 hollow stem auger holes were drilled between Hamilton-Victoria Street and the Pacific Ocean, as part of Phase I of this study. Between 1982 and 1985, the investigation was continued with additional hollow stem and bucket auger holes drilled between Weir Canyon Road and the Pacific Ocean. A complete listing of the investigation, including locations, depths and equipment types, is shown in table 6.

3-04 Generally, the borings were started on the levee crest and were extended down into the foundation materials. Occasionally, borings were made on the landside of the levee where access was a problem, or where a new levee alignment was being considered. The materials encountered were visually logged. Disturbed samples of the materials were obtained from each boring at intervals of 3 feet, or less if the material changed. Representative, undisturbed drive samples were obtained of the finer grained and cohesive materials.

3-05 Standard penetration testing was conducted in each boring in accordance with ASTM D 1586, at approximately 3-foot intervals.

3-06 The logs of investigations by the Corps of Engineers are presented on plates 8 through 27.

Drop Structures and Stabilizers

PREVIOUS INVESTIGATION

3-07 The foundation investigations conducted for the County of Orange, for the existing drop structures and stabilizers are included within this report as a source of general information on foundation conditions. The specific investigations are referenced in table 4.

RECENT PIELD INVESTIGATION

3-08 Bucket auger and backhoe were used to sample the representative materials for the proposed drop structures and stabilizers.

3-09 The foundation materials encountered were visually logged. Disturbed samples were obtained for laboratory testing of each material type, at depth intervals of 3 feet or less. Standard penetration testing was conducted in each boring, at approximately 3 foot intervals.

Invert

PREVIOUS INVESTIGATION

3-09 There are several invert investigations, conducted by other agencies that were considered in preparing this report. The previously conducted levee investigations, which contain information on foundation conditions adjacent to an invert location, were also used to supplement the Corps of Engineers' investigation of the invert materials.

RECENT FIELD INVESTIGATION

- 3-10 The primary means of obtaining representative information about the invert materials was a series of backhoe trenches excavated between 1979 and 1985. Each trench went approximately to the depth of the proposed invert. In addition to the backhoe trenches, several bucket auger holes were also drilled within the invert. The location and depth of each exploratory hole along the invert are included in table 6.
- 3-11 Disturbed representative samples of the invert materials were obtained from each trench or hole at intervals of 3 feet, or less if the material changed. Densities were determined by standard penetration testing at approximately 3 foot intervals within the borings.

Borrow

3-12 The source of borrow for the project will be both the required invert excavation and existing levees in the reaches which are to be realigned and reconstructed. As a result, the sources of borrow were investigated as part of the previously discussed levee, foundation and invert investigations.

Revetment

3-13 The design stone revetment along the lower Santa Ana River varies in gradation and in thickness as indicated on both plate 2 and table 1. Most of the existing riprap placed prior to 1970 was designed for a 400-pound maximum stone size (W50 of approximately 120-pound) based upon the Corps criteria set forth in EB 52-15, "Slope Protection". Subsequently placed riprap was designed for a 750-pound maximum (W50 of approximately 200-pound) stone, which was designed using EM 1110-2-1601, "Hydraulic Design of Flood Control Channels". The 400-pound stone was specified to be placed in an 18 inch thick layer, and the 750-pound stone in a 24-inch thick layer. The levee revetment was inspected by Geotechnical Branch personnel in 1983 and 1987, and the stone visible at the ocean jetties was inspected in 1986. Results of the inspections are discussed in section V.

Santa Ana Canyon

3-14 Subsurface investigations of foundation material for both the drop structure (TH 87-1, 2 and 3) and the Green River Golf Course area (TH 87-4, 5 and 6) were conducted in April 1987, and July 1987, respectively. A 24-inch bucket auger was used in obtaining disturbed samples. Densities were determined by Standard penetration testing (SPT) at approximately 5-foot intervals during the first 20 feet of exploration. Location of the borings and logs are shown on plate 27. Depths of the borings ranged from 23 to 43 feet at the drop structure site, and 40 to 49 feet at the golf course site.

Disposal Beach

3-15 Approximately 15 miles of beach, adjacent to the mouth of the river, were evaluated as possible disposal sites for the required invert excavation materials from the lower Santa Ana River. Twenty-four transects, or lines, perpendicular to the proposed disposal beach were surface sampled at every 6-foot change in elevation from +12 to -30 feet MLLW. The sampling was done in October 1982. The sample locations are shown on plate 28.

IV. LABORATORY TESTING

General

4-01 Laboratory testing of all the materials sampled during geotechnical investigation were conducted to determine mechanical analysis, Atterberg limits, and moisture content. The samples were classified in accordance with the Unified Soil Classification System. The logs of the Corps test sites are shown on the investigation plates 8 through 27. Tests of remolded and undisturbed samples were conducted by the South Pacific Division (SPD) Laboratory to determine shear strengths, permeabilities, compaction properties and consolidation characteristics. The tests were performed in accordance with Engineering Manual EM 1110-2-1906, "Laboratory Soils Testing," dated 30 November 1970. The soil test results are contained in attachment 1. Summaries of the testing are shown in tables 7 and 8.

4-02 The statistical summaries of the mechanical analyses are presented in table 9. The summaries are for each reach of the river, for the sites of the proposed drop structures, and for the proposed invert borrow areas. Composite summaries are typically for the materials in a potential borrow area materials and frequency summaries are generally for the materials that are to remain in place.

Levee Material

4-04 Representative disturbed samples from the levee embankments were tested to determine gradations, Atterberg limits, and moisture contents. Samples of the typical material types were compacted by both ASTM methods D 698 and D 1557, for maximum density and optimum moisture determinations. Representative material types were then remolded for R-type triaxial and direct shear strength tests at densities typical of the existing or proposed embankment conditions.

Foundation Material

4-04 The foundation samples were tested to determine gradations, Atterberg limits, and moisture contents. Disturbed samples of typical material types were compacted in accordance with both ASTM D 698 and D 1557 in order to determine maximum density and optimum moisture content. Remolded materials were subjected to R-type triaxial strength testing at densities typical of the existing conditions. Undisturbed samples were subjected to unconfined strength testing, R-type triaxial strength testing, and consolidation and permeability testing.

Invert Materials

4-05 Disturbed samples, representative of the invert materials, were tested to determine gradations, Atterberg limits and moisture content. Typical materials were compacted by both methods ASTM D 698 and D 1557 in order to determine maximum density and optimum moisture characteristics. Representative samples were remolded to typical in situ densities in order to determine R-type triaxial strengths and permeabilities.

Revetment

4-06 Recent quality compliance testing has been conducted on existing quarry sources in the project area. In addition, samples of the existing levee riprap material were collected for quality compliance testing. Stone samples from both the quarries and river levees were subjected to the following tests: petrographic and x-ray diffraction analysis, specific gravity and absorption, wetting and drying, Los Angeles abrasion and magnesium sulfate soundness. The results of petrographic analyses and research of historic records were used to determine possible quarry sources for the levee riprap. See table 10 for the compliance test results.

Disposal Beach

4-07 The materials from the proposed disposal beach were tested by performing a mechanical analysis on each disturbed sample. The composite average of all samples along each particular range sampling line was then computed to determine the representative gradation of that section of beach. The composite averages of all sampled range lines are shown in table 11.

V. GEOTECHNICAL CONDITIONS

Weir Canyon Road to Imperial Highway, (Reach 1)

5-01 The materials in the streambed foundation and in the existing levees in reach 1 are predominantly well-graded, noncohesive sands with significant but varying amounts of silt and gravel. Up to 20 percent cobbles to 6 inches in diameter are present in many areas that were explored, along with occasional boulders up to 2 feet in diameter. Atterberg limits tests conducted on the samples from this reach indicate that clayey fines are relatively uncommon. However, layers of sandy silt up to 6 feet thick were found at three locations, though generally below the proposed invert elevations. Groundwater was encountered under the right levee adjacent to Yorba Regional Park at depths ranging from 15 to 18 feet in four test holes. Natural moisture contents above the water table were mostly between 2 and 8 percent in the sandy materials and between 19 and 40 percent in the silty layers. The sand and silty sand materials are generally medium dense to dense as indicated by SPT blow counts in the range from 11 to 40. However, loose layers with blow counts less than 10 were commonly encountered during the exploration.

5-02 The active streambed materials in the invert are poorly-graded, noncohesive sands with virtually no fines and up to 40 percent gravel. Occasionally, cobbles and boulders up to 15 inches in diameter were encountered. Groundwater was encountered at depths of 5 feet or less. Densities were estimated to range from loose to medium dense, based on visual observations and ease of excavation.

5-03 Based on water level data from the exploration program, the ground-water table appears to maintain a gentle downstream gradient, from elevation 293 feet just downstream from Weir Canyon Road, to elevation 267 feet just upstream from Imperial Highway. This would result in groundwater being at elevations ranging from 0 to 10 feet below the proposed channel invert. The gradient for the 1986 groundwater (deeper zone) profile shown on plate 6 is much steeper for this same reach. The water table drops from elevation 293 feet near well 35/8W-30R01 to elevation 248 feet near well 45/9W-2B03. Water

levels within this reach of the project are probably influenced to varying extents by low flows within the channel and by irrigation and seepage from small ponds at the park, and therefore, would be expected to undergo seasonal or yearly fluctuations.

5-04 An inspection of the existing river levees between Weir Canyon Road and Imperial Highway determined that the existing stone revetment generally does not meet the original size and thickness requirements as discussed in paragraph 3-13. The rock also tends to be of unsuitable quality. Various lithologies are represented in the levee riprap. However, the predominant rock type, as classified petrographically, is a gray, moderately hard to hard, slightly to moderately weathered, porphyritic meta-andesite. Individual pieces contain numerous rust stained surfaces and incipient fractures. These fractures, which are generally open but occasionally filled with quartz or calcite, are present in random orientations. It was estimated that up to 70 percent of the volcanic rocks contain these fractures, which can part very easily under only light to moderate hammer blows, and occasionally hand pressure. Numerous individual pieces were observed to be breaking down along these planar discontinuities which may explain the apparent undersized nature of the riprap. Only minor amounts (probably 1 percent) of soft, decomposed to highly weathered rock were noted. Minor rock types identified by field or laboratory methods include a mottled white and black, slightly weathered, hard, fine to coarse grained granodiorite; a pink and gray, hard, slightly weathered micropegmatitic granite; and a tan to gray, moderately hard, slightly to moderately weathered, fine to coarse grained arkosic sandstone. These rock types, in contrast to the meta-andesite, are generally sound, with only minor breakdown and decomposition noted. The levee riprap is typically subangular to angular in shape. Only the sandstone tends to exhibit more pronounced subrounded edges. North of the Imperial Highway bridge, an overlay of fresher, larger, more durable andesite rock was apparently placed. The rock in reach 1 is generally poorly graded and ranges in size from 2 to 8 inches, with a random maximum rock size of from 1 to 2 feet. Significant breakdown in localized areas on the grade has resulted in patches of 1- to 2-inch diameter rock. It appears that the stone revetment was probably obtained from local sources in the Corona-Riverside area. The meta-andesite rock appears to be diagnostic of material from the Harlow Quarry near Corona while the Riverside quarries may be possible sources for the granodiorite. The granite may have been obtained from the Magnolia Quarry near Corona. The sandstone is not indicative of a known quarry source but might represent material obtained from the local streambed.

Imperial Highway to Katella Avenue, (Reach 2)

5-05 In reach 2, the materials along the left bank, invert and right bank are significantly different. The differences are due to the various methods utilizied to place the materials in their present position.

5-06 The left bank is largely composed of natural alluvial deposits laid down over a period of time when the river channel meandered through the area. Its stratifications, therefore, include a variety of materials ranging from clays to sandy gravels, distributed somewhat randomly with depth. The majority of the materials are noncohesive sands with varying amounts of silt and gravel. Both well-graded and poorly-graded layers are common, as are cobbles in the 3 to 6 inches range. Occasionally, larger boulder size rocks were encountered. Fine grained clays, silts, and clayey or silty sands occur at various depths in layers up to 11 feet thick throughout the reach. Subsurface water. primarily the result of a mounded condition due to low flows in the channel, was encountered at depths ranging from 16 to 29 feet in about half of the test holes. Subsurface water was not observed in other test holes drilled to depths ranging from 35 to 40 feet in this reach. The natural water contents above the water levels ranged from 1 to 19 percent in the granular materials, and from 6 to 34 percent in the fine-grained clays and silts. Most of the materials are medium dense to dense, as characterized by SPT blow counts in the range from 11 to 50. However, significant numbers of loose layers are indicated by blow counts between 4 and 10, mostly in relatively clean sandy materials with few fines. The widely varying densities of these naturally occuring alluvial materials reflect the depositional environment and energy level present at the time of their formation. Because the historic floodplain in this area is relatively wide and level, layers of soft or loose materials are assumed to extend over significant areas instead of occuring in isolated pockets. Stability analysis (described later) of critical levee sections reflects the occurence of these weak layers in the foundation and levees.

5-07 The right bank of the river in this reach is a combination of natural alluvial deposits and a built-up levee section which separates the main channel from a parallel series of groundwater recharge basins. Nearly all of the materials in the upper portions of the right bank and levee are noncohesive sands with varying amounts of silt and gravel. Cobbles up to 4 inches are common, along with occasional larger cobbles and boulders. Clayey and silty materials, in layers 3 to 11 feet thick, are commonly encountered, but only from depths of 15 to 30 feet below the top of the levee. However, just downstream from Imperial Highway, a layer of hard sandy clay is located at a depth of 9 feet below the top of the levee. Blow counts in the range from 13 to 60 indicate that the most of the materials along the right bank are medium dense to very dense. Relatively few low SPT blow counts indicating loose material were recorded, and these were nearly all in noncohesive sands below a depth of 20 feet. The foregoing gradation and density data verify that the upper portions of the right levee are predominately compacted fill materials, likely obtained from streambed excavation, and the lower sections are composed of both compacted fill and natural alluvial materials. Subsurface water, primarily related to low flows in the channel, was encountered in 12 of the 20 test holes drilled in this reach, at depths ranging from 15 to 22 feet below the top of the levee.

The test holes in which subsurface water was not observed were drilled to depths of 34 to 43 feet. The water levels under the right levee would be expected to vary seasonally in general response to the presence and depth of water in the adjacent groundwater recharge basin. Natural water contents above the water levels were found to range from 3 to 16 percent in the sandy materials and from 13 to 37 percent in the silty and clayey materials.

5-08 The active streambed materials are predominately clean, noncohesive poorly-graded sands and gravelly sands, with occasional thin layers of silty sand or fine-grained silt or clay. Relatively few cobbles and boulders were encountered during exploration. Subsurface water was at a depth of 1.5 to 14 feet below the surface in three of the test holes in the streambed, and was not observed in five other test holes drilled to depths from 7 to 17 feet. The unconsolidated invert materials are very loose near the surface and medium dense below the active streambed depth, with SPT blow counts ranging from 3 to 16.

5-09 A comparison of water level data from the published literature and the field exploration program indicates that within the reach one mile downstream from Imperial Highway, water levels observed in the test holes and test trenches probably reflect the regional groundwater table. Downstream from that reach, subsurface water levels are probably indicative of a more localized perched water table associated with a mounded condition due to low flows in the active channel and the adjacent groundwater recharge basins. Composite water levels in the deeper zone of fresh water aquifers drop very rapidly in this lower reach (see pl. 6), to depths well below the proposed channel invert. Information on the shallow semi-perched zone within this reach of the project was not available but water levels in this zone would probably also be below the influence of construction activities. Subsurface water was encountered during the field exploration program at elevations ranging from 2 feet above to 15 feet below the proposed channel invert.

5-10 An inspection of the existing river levees between Imperial Highway and Katella Avenue determined that the condition of the stone revetment is similar to that in reach 1 because of breakdown along fracture planes in the volcanic rock. Two major rock types were noted during the field inspection, the volcanic andesite characteristic of reach 1 and a dark gray, fine to medium grained, moderately hard to hard, slightly to moderately weathered, undifferentiated granitic rock. The petrographic analyses distinguished two volcanic and three granitic rock types. The volcanic lithologies were composed of the meta-andesite and an associated meta-dacite. The granitic rocks consisted of diorite, granodiorite and gabbro/meta-gabbro. The amount of incipient fracturing observed in the volcanic rock varied from approximately 50 percent near Lakeview Avenua and the Riverside Freeway, to 60 to 70 percent downstream near Ball Road. Less fracturing and rust staining, but more decomposition was noted in the granitic rocks. The amount of soft, highly weathered to decomposed rock ranged from less than 5 to 15 percent. The rock is predominantly subangular to angular in shape, although localized decomposition has resulted in more subrounded rock surfaces. Rock sizes at the different sampling sites were more variable. Larger well graded rock (generally ranging from 3 to 12 inches) was common near Lakeview Avenue and Glassell Street. Poorly graded rock near the Riverside Freeway and Ball Road generally ranged from 2 to 8 inches in diameter, while poorly graded rock, usually between 2 and 6 inches in diameter (with scattered areas of 1- to 2-inch rock) was noted near Lincoln Avenue. A random maximum rock size of 2 feet was common throughout reach 2 except near Lincoln Avenue, where a random maximum size of only 8 to 10 inches was observed. Local quarries in the Corona-Riverside area again appear to be the most likely sources for the stone revetment. The volcanic rocks were probably obtained from the Harlow Quarry while the Corona Pacific Quarry and the Riverside quarries may have supplied the granitic rock types.

Katella Avenue to Santiago Creek, (Reach 3)

5-11 The condition of the foundation and levee materials in reach 3 are controlled by the existing fine-grained materials more so than in the upstream reaches. Silts, clays, and silty and clayey sands are the predominant materials throughout the reach, although significant quantities of relatively clean sands were encountered in test holes drilled through the left levee between Katella Avenue and the Santa Ana Freeway. Very few cobbles were encountered. Subsurface water was measured at depths from 12 to 28 feet in seven of the test holes. No subsurface water was observed in the other twelve test holes, which were drilled to depths ranging from 25 to 36 feet. Natural moisture contents above the water levels ranged from 1 to 17 percent in relatively clean sands, and from 3 to 39 percent in the fine-grained material. Most of the sandy materials are medium dense to dense, with SPT blow counts in the range from 11 to 50. Occasionally, loose layers with blow counts less than 10 were encountered in the levee foundations. Silts and clays are generally of a medium to stiff consistency, with SPT blow counts in the range from 5 to 15.

5-12 The surficial materials in the active streambed, to a depth of 3 feet, are poorly-graded, noncohesive sands with less than 2 percent gravel or fines. The foundation materials below this unconsolidated layer range from sand and silty sand in the upstream half of the reach to silt at the lower end. Cobbles, up to 4 inches, were only rarely encountered. Subsurface water was encountered at the top of the silt layer just downstream from the Santa Ana Freeway, but not elsewhere in the invert. Densities were estimated to range from very loose near the surface to medium dense with depth, based on visual observations and ease of excavation.

5-13 Subsurface water encountered during the field exploration program is generally the result of a mounded condition due to low flows in the channel. The groundwater profiles for the shallow semi-perched zone and the deeper fresh water aquifers, as shown on plate 6, are well below the proposed invert of the channel. Subsurface water levels would be at elevations ranging from 6 feet above to 15 feet below the proposed channel invert.

5-14 An inspection of the existing river levees between Katella Avenue and Garden Grove Boulevard revealed that the stone revetment, in contrast to the upstream reaches, is generally in good condition and therefore would be suitable for reuse in project construction. Two major rock types were noted during the field inspection, the volcanic andesite characteristic of Reaches 1 and 2, and a medium to dark gray, hard, fresh to slightly weathered, fine to coarse grained granitic rock, resembling a quartz diorite. The volcanic rock is the dominant type between Katella Avenue and Orangewood Avenue, while the granitic rock predominates downstream of Orangewood Avenue. Petrographic analyses again confirmed the presence of the meta-andesite and a variety of granitic rocks, including diorite, monzodiorite and granodiorite. The volcanic rock is of better quality than that described previously, with only about 30 to 50 percent of the individual rocks containing incipient fractures. Only localized pockets of highly weathered to decomposed material (probably less than one percent of the total rock mass) were observed. The granitic rock is generally sound and durable. The individual rocks tend to be subangular to angular in shape and very little rust stained, cracked or decomposed rocks were present. A slight increase in weathering was observed near the Garden Grove Freeway. The granitic rock is mostly well graded, 4 to 12 inches in size, with random maximum sizes of between 2 and 3 feet. The granitic rock tends to be larger and more durable than the volcanic rock. The volcanic rock is generally poorly graded and ranges in size from 2 to 10 inches, reaching a random maximum diameter of from 2 to 3 feet. The stone revetment was most likely obtained from the same sources mentioned for Reach 2.

Santiago Creek to 17th Street, (Reach 4)

5-15 The foundation materials in this reach are predominantly silts, clays, and silty and clayey sands, with cleaner sandy materials derived from the streambed in the built up levee sections. Relatively little gravel and pratically no cobbles were encountered during the investigation. Subsurface water was present at depths ranging from 15 to 26 feet in four test holes in the upstream half of the reach, and was not observed in the three test holes which were drilled to 30 feet in the downstream half. Natural moisture contents above the water levels ranged from 2 to 13 percent in the relatively clean sands, and from 12 to 37 percent in the finer-grained materials. The density of the sandy materials are mostly medium dense to dense, with occasional layers of loose material, as determined from SPT blow counts ranging from 5 to 38. The clayey and silty materials generally had blow counts in the range from 5 to 15, indicating medium stiff to stiff consistencies.

5-16 As in the upstream reaches, the surficial streambed materials in reach 4 are relatively clean, poorly-graded, noncohesive sands to an average depth of about 3 feet. These are underlain by moderately consolidated alluvial deposits varying from clays to sands. Subsurface water was not encountered in the relatively shallow exploration conducted in the invert of reach 4.

5-17 Subsurface water encountered during the field exploration program is generally the result of a mounded condition due to low flows in the channel. The groundwater profiles for the shallow and deeper zones, as shown on plate 6, would be below the influence of any construction activities. Subsurface water levels would be at elevations ranging from 5 to 20 feet below the proposed invert of the channel.

5-18 The existing slope protection, inspected in 1983 and found to be of acceptable quality, has since been removed from the right bank of the river downstream of the Santiago Creek and Santa Ana River confluence.

Seventeenth St. To Fairview Channel, (Reach 5)

5-19 The foundation conditions in this reach include the condition of the active streambed as well as deeper materials. The active streambed materials, located at or near the surface of the existing streambed, are mostly silty sands with occasional gravel and cobbles to 12 inches. Moisture contents of the streambed materials ranged between 25 to 30 percent and indicate that the materials are saturated. These materials will be excavated to the proposed invert elevation. The foundation materials at the proposed invert elevation are predominantly loose to medium dense sands and silty sands with 1- to 3-foot thick lenses of medium stiff to stiff sandy silts and sandy clays. The plasticity of the clay lenses increases between Harbor Boulevard and the Fairview Channel. Typical SPT blow counts in the sands and silty sands ranged from 9 to 20 blows per foot, and in the silts and clays from 5 to 15 blows per foot. Water well data indicate that upstream of the San Diego Freeway, current (1986) maximum groundwater depths increase from 20 to 90 feet below the proposed invert elevation. However, the shallow semiperched zone is only 5 feet below the proposed channel invert elevation near the San Diego Freeway, increasing to 20 feet below the invert elevation near Seventeenth Street. Subsurface water, the result of a mounded condition due to low flows in the channel, was encountered during exploration. Between the San Diego Freeway and the Fairview Channel, groundwater was observed at an elevation as high as 5 feet above the proposed channel invert. Although groundwater levels in the areas surrounding the channel alignment may vary by more than 10 feet seasonally, perennial low flows in the channel keep the proposed invert area wet year round.

5-20 The channel embankment materials are primarily sands and silty sands with occasional 2- to 3-foot thick clay and silty lenses to the invert elevation. Between Seventeenth Street and Harbor Boulevard, the materials are loose to medium dense, and between Harbor Boulevard and the Fairview Channel, the materials are primarily medium dense. Moisture contents encountered typically range from 5 to 15 percent.

5-21 Materials from the required excavation for the proposed improvements are generally active streambed material, as described above. The gradations of materials to be excavated are summarized statistically for various reaches in table 9.

5-22 Slope protection within this reach of the channel consists of 6 inches of reinforced concrete or 4 to 8 inches of reinforced concrete on 3 inches asphaltic concrete.

Fairview Channel to Hamilton-Victoria Street, (Reach 6)

- 5-23 The foundation materials in this reach, not including the active streambed materials, are primarily silts and clays but a significant amount (about 30 to 40 percent) of the soils are silty sands. Much of the fine grained material is highly plastic with plasticity indices of 35 to 40. These silts and clays are typically stiff to very stiff with SPT blow counts ranging between 10 and 30. Clay layers encountered were up to 15 feet thick and extend well below the proposed invert elevation. The silty sands are typically medium dense to dense with SPT blow counts between 20 and 40. Subsurface water, primarily groundwater, was encountered at depths ranging from 15 to 20 feet from the top of the levees (from 10 feet below to 5 feet above the proposed invert) throughout the reach. Thus, foundation materials in the reach are typically saturated. The materials remain wet in this reach year-round due to flow in the channel and the tidal surges from the mouth of the river.
- 5-24 Embankment materials in this reach are primarily silty sands but high proportions of clay and silt are present. Clays in the embankment are generally not highly plastic and are found in layers up to 5 feet thick. Embankment materials are medium dense and typical moisture contents range from 10 to 25 percent.
- 5-25 The active streambed materials in this reach are generally very fine grained. Silt and clay were the most frequently encountered material, but there are also some small lenses of silty sand and sand. Particles larger than 3/8 inches were not found. Within the existing channel, groundwater was encountered at depths from about 1 to 20 feet below the existing invert elevation; that is, from about 10 feet below to 5 feet above the proposed invert elevation.
- 5-26 Slope protection in this reach of the channel consists of 6 inches of reinforced concrete.

Hamilton-Victoria Street to Pacific Ocean, (Reach 7)

5-27 Foundation materials in this reach are generally silty sands and poorly graded sands. These materials are medium dense to very dense with SPT blow counts typically between 20 and 60. Groundwater remains high in this reach year-round due to flow in the channel and to tidal surges from the mouth of the river. As a result, moisture contents in the foundation are at or near saturation levels.

- 5-28 The embankments within this reach are composed primarily of silty sands, however, significant lenses of silt and/or clay up to 5 feet thick were encountered. The materials are medium dense to loose, and moisture contents vary over a wide range, typically between 10 to 30 percent.
- 5-29 Materials at or below the proposed invert elevation are mostly sands and silty sands. Occasional silt layers up to 2 feet thick were found primarily at the proposed invert elevation. Particles larger than 3/4 inches are not encountered and materials are generally saturated.
- 5-30 An inspection of the stone jetties at the mouth of the Santa Ana River in Huntington Beach determined that the 1/2 to 3-ton capstone is generally in good condition even after a maximum 30-year service record. The majority of the rock is fresh to only slightly weathered, with less than one percent breakdown noted. The dominant rock type present appears to be a medium to dark-gray, fresh to slightly weathered porphyritic andesite. The fresher, dark gray rock is located mostly in an approximate 300-foot section on the east jetty which was restored under a Corps contract in 1970. Minor amounts (approximately 10 percent) of a light gray to medium gray, slightly to moderately weathered porphyritic andesite and a light gray, coarse grained granodiorite are also present. The lighter colored andesite is characterized by numerous healed to rust stained incipient fractures and surface coatings of hematite and limonite. Most of the rock breakdown noted appeared to have occurred along these fractures. Most of the rock placed on the jetties probably came from the Harlow Quarry, south of Corona.

Santa Ana Canyon

- 5-31 The foundation material at the drop structure consists of most sandy silts and clays, silty and clayey sands with some layers of poorly graded sands and gravels to 3 inches. Moisture contents range from 3 to 12 percent in the coarser materials, and from 28 to 46 percent in the finer materials. Some cobbles are encountered below 20 feet. Standard penetration testing (SPT) indicates that materials in TH 87-1, located on the south side of the drop structure, are loose with blow counts ranging from 3 to 9. The other two holes (i.e. TH 87-2 and 3), on the north side, indicates an increase in density naving blow counts ranging from 11 to 40. Groundwater was encountered approximately 20 feet below the ground surface.
- 5-32 At the Green River Golf Course area, foundation materials are generally coarser than those found at the drop structure. They are composed of poorly graded sands, and silty sands with some layers of poorly graded gravel and sandy silts. Drilling in this area required drilling fluid within the first 5 feet. SPT data taken within material above 15 feet indicate that it is loose with blow counts below 15. Below this zone, the material increases in density, which was reflected by an increase in drilling effort. Penetration tests in these zones were not done due to the gravel and cobbles. Groundwater was encountered approximately 20 feet below the ground surface.

VI. ANALYSES

Levee Analysis

DESIGN VALUES

6-01 Representative design values have been selected for the foundation, levee and other construction materials. The selected design values are based on the results of detailed laboratory testing conducted on disturbed samples of representative materials from the foundation, levee, and invert; and on previous tests on similar materials from other projects; and on extensive construction experience with alluvial and streambed materials in the general vicinity of the project. Because the exploration revealed a wide variety of material types, and numerous loose or soft layers in the foundation and levees, laboratory tests were conducted on the various materials compacted to both 80 and 90 percent of maximum density as determined by ASTM test method 1557. The 80 percent compaction values were chosen to simulate the loose layers of in situ materials, and the 90 percent values were chosen to approximate the firmer in situ foundation and levee materials, and to represent the expected densities in the compacted levee embankment materials. The moisture-density relationships established by compaction studies and in situ foundation tests were used to determine the dry and moist unit weights. The saturated unit weights were determined by calculating the volume of voids at 80 and 90 percent of maximum density and assuming those voids were filled with water. The shear strength and cohesion values selected are interpretation of consolidated undrained triaxial compression test data, with pore pressure measurements used to determine consolidated drained values (R-type test). Conservative permeability values for calculating seepage through the levees were chosen from test results on similar materials. The adopted design values for the various materials in the foundation and levee are shown in the following table.

SEEPAGE

6-02 The proposed levees were analyzed for potential through seepage on the landside slopes. The seepage analysis addresses both the concerns of quantity of flow and of the factor of safety against piping.

LOWER SANTA ANA RIVER
THE ADOPTED FOUNDATION AND
LEVEE DESIGN PARAMETERS.

TABLE B

UNIT MEIGHT DENSE	COMPACTION	ED AVERA		124 111 123 132	122 105 117 129	128 117 127 136	122 106 120 129	123 107 121 130	124 111 122 131	128 117 127 136
UNIT WEIGHT LOOSE	(COMPACTION)	MOIST	ME IGHI	109	104	112	106	107	109	113
<u> </u>	MOO)	AVERAGE	WEIGHT SA (PCF)	66	94	104	94	95	86	104
	, 1.1	TION	COHESION C (PSF)	200	100	0	0	0	0	100
RENGTHS	DENSE	COMPACTION	FRICTION ANGLE (DEGREES)	30	32	37	36	34	35	32
STREN	NOI	COHESION C (PSF)	200	80	0	0	0	0	100	
S	T.0005E	(COMPACTION)	FRICTION ANGLE OFGREES	24	97	32	31	87	30	56
				009	400	0	0	300	0	400
GTHS	DENSE	90% COMPACTION	FRICTION COHESION ANGLE C C OFCREES) (PSF)	23	25	35	33	30	32	27
STRENG		(NO1.	(<i>PSF</i>)	009	200	0	0	200	0	400
OΣ	3500T	(COMPACTION)	FRICTION ANGLE (DEGREES)	15	20	28	27	24	56	22
OPTIMEN	MOISTURE		(\$)	11	21	8	13	12	11	8
PAXINA	DRY	WEIGHT	(PCF)	121	117	130	118	119	123	130
DESIGN		/	SOIL	CLAY	ITS VI-2	SILTY GRAVELLY SAND	SAND	SILTY	SAND/ SILTY SAND	CLAYEY SAND

6-03 Variables that significantly affect the seepage analysis are the levee height (including decreases in invert elevation), the slope of the levee faces, the ground level behind the levee, the elevation of impervious layers, and the water level. The levee side slopes were set to be 1V on 2H, the top width was set at not less than 15 feet to allow for construction and maintenance equipment access, and the water surface was established at the maximum flood elevation, with 3 additional feet of freeboard determining the levee height. The transient flow condition was determined for the design flow period of just more than 4 days, although the maximum design water level would actually exist for less than 2 days.

6-04 A permeability for the embankment and foundation materials of 10 ft/day was selected as a value representative of the lower quartile gradations, from the frequency studies of samples. The seepage exit points were estimated for the different levee heights typical of those conditions found in the project area, and were then compared to the ground heights behind the levees. All of the areas in which the ground height behind the levees is above the exit point were eliminated from further analysis as they would not develop seepage problems. There are percolation ponds on the backside of the right side of the levee in reach 2. For the purpose of the seepage analysis, the ponds were assumed to contain water to their weir elevations during floodflows. This assumption allows areas where the exit point is lower than the weir elevation to be eliminated as a seepage problem area due to the fact that the water on the backside of the levee would counteract the seepage forces.

6-05 The remaining levee areas were then analyzed to determine the extent of any seepage that might occur. The sections analyzed within each reach included those with the greater typical heights on both sides of the levee. The critical seepage sections within reaches 1 through 4 were developed as a 15-foot high levee on an impervious base. The maximum seepage quantity for the brief period of maximum design flow was calculated to be less than 20 cubic feet per day per lineal foot of levee, with a factor of safety against piping of about 2. The critical seepage sections within reaches 6 and 7 were develoed as a 22-foot high levee with groundwater at the invert elevation. The maximum seepage quantity within this area was calculated to be about 30 cubic feet per day per lineal foot, with a factor of safety against piping of about 2. The factors of safety against piping are considered conservative since they are based upon steady state conditions rather than the transient seepage condition, as discussed in subparagraph 6-03. The quantity of seepage is not considered a concern other than a consideration for the hydraulic design of side drainage. Rainfall behind the levees, for any storm large and long enough to develop seepage through the levees, would be added to the calculated seepage quantities, and the resulting quantities would be contained by the side drainage system. Local sections of levee that are affected by the design seepage conditions are listed in the following table:

Table C. Levee Areas Possibly Affected by Seepage.

Station	Reach	Levee	Comments
830+00*	2	Right	
740+00#	2	Right	
710+00*	2	Right	
640+00*	3	Left	
610+00*	3	Right	Left & right levees contained within higher existing banks.
150+00			-
to 0+00	6/7	Right	Private property on backside of right levee.

^{*} Seepage within sections 1,000 feet in length unless noted otherwise.

SLOPE STABILITY

6-06 This analysis of the slope stability is based on the recommended plan. The stability of the levee slopes (including the trapezoidal portion of reach 5) was initially analyzed for the existing soil conditions, and additionally analyzed for new construction conditions where the proposed alignment would require placing new material.

6-07 Cross-sections representing typical and composite soil conditions were developed for both the left and right levees. Typical cross-sections generally represent the most common soil conditions encountered during the field investigation and composite cross-sections generally represent weak materials (such as loose sand, low strength silt and clay) and locally higher levees. Material types and properties used in the analysis were determined from field investigations and laboratory test results. The cross-sections have a top width of not less than 15 feet, and 1V on 2H side slopes. They are analyzed for end of onstruction, critical flood stage, sudden drawdown, steady seepage, and earthquake slope stability cases as required by EM 1110-2-1913. See plates 29 through 38 for representative cross-sections, including the failure arcs and a table of the safety factors obtained.

General conditions of the existing or new embankments and foundations are identified for each of the required slope stability cases. These conditions form the basis for the slope stability analysis, and are discussed in the following paragraphs:

end of Construction. Slope stability for the case of end of construction takes into consideration any build up of pore pressure in impervious soils during the construction period. A major portion of the proposed levee construction will utilize existing levees, and, therefore, the end of construction condition would not be applicable. There will be some relocation and construction which would generally utilize free-draining materials and, therefore, consolidated-drained, S, shear strengths have been used for the end of construction analysis. For areas in reaches 3 through 7, construction of new levees may utilize a less pervious material. Although the less pervious materials are expected to drain faster than construction proceeds, consolidated-undrained, R, shear strengths have been conservatively used for the analysis.

The end of construction condition was analyzed for reaches 1, 3, 5, 6, 7 and the Canyon for newly constructed embankments and Reach 4 for new material placed on existing embankments. The analyses indicate factors of safety above the minimum required.

during prolonged flood stages in which the levee embankments may become saturated and develop a condition of steady seepage. Shear strengths for the less pervious soils were defined by a strength envelope midway between the R and S test envelopes for high normal stresses, and with the S strength envelope for low normal stresses. For free-draining materials, the slopes were analyzed with the S strength envelope. Most of the existing materials in the levees and the proposed borrow materials, are free-draining and the S strength envelope was used in the analyses. However, some of the existing materials in the lower reaches, 3 through 7, are not free-draining and the combined R and S strength envelope, as discussed above, was used for the critical flood stage analyses.

Each of the levee cross-sections was analyzed with the water level at the design flood stage. All factors of safety for these analyses were above the required minimum factor of safety of 1.4.

Sudden Drawdown. In general, the sudden drawdown analyses are based on the conservative assumption that the embankments are saturated and remain saturated during drawdown when the water surface is lowered instantaneously from maximum design flood stage to the minimum stage at the invert. Where the above conservative assumption resulted in factors of safety less than required, a more realistic condition was assumed and analyzed.

This condition took into account the fact that the time required for the flood waters to recede is estimated to be at least 3 days, and that, for most of the levees, the existing materials and the proposed borrow materials are free-draining. These conditions allow drainage of the slope face to proceed concurrently with the lowering of the flood waters. However, in areas of Reaches 3 and 7, some of the existing materials are not free-draining and the general assumption that pore pressure does not dissipate would be the more representative approach. For free-draining materials the S shear strengths was used and for less pervious materials the minimum of the R and S shear strength envelopes was used in the sudden drawdown analysis.

Each of the levee cross-sections analyzed for sudden drawdown met or exceeded the required factor of safety of 1.0.

Steady Seepage. The condition of steady seepage occurs when water levels remain at the flood stage long enough to develop a steady state phreatic surface through the limited sections of levee not paved or grouted. Hydrographs for the Santa Ana River indicate that the maximum flood waters will be of a duration just long enough to dewelop the condition of steady seepage with the more pervious levee materials. The stability analyses for the case of steady seepage were performed for the landside slopes. For less pervious materials, a shear strength envelope which uses S strengths for low normal stresses and an envelope midway between the R and S test envelope for higher normal stresses were used. The S strength envelope was used for freedraining materials. Even though conservative values were chosen for analyzing the steady seepage condition, the full phreatic surface would only develop for storms of the magnitude of 100-year or greater.

All the cross-sections developed a factor of safety equal to or greater than the minimum required 1.4 for steady seepage without earthquake. The acceptable factors of safety, even for the more shallow stability arcs (3- to 5-feet deep) within cohesionless embankment materials, indicate that sloughing of the slopes due to the short term steady seepage will not be a concern.

- Earthquake. The slope stability cases of end of construction, critical flood stage, and steady seepage were analyzed with earthquake forces. The representative design coefficient of 0.15 g for the earthquake case was selected in accordance with EM 1110-2-1902, after a combined seismic and flood risk analysis determined that the use of maximum probable accelerations to preclude the release of only occasional floodflows (as quantified below), was not required.
 - (a) The calculated combined risk associated with a 0.2 g local surface acceleration produced by an earthquake on the San Andreas fault, is less than 0.0007 during a period of design flow.

(b) The calculated combined risk associated with a 0.45 g near field surface acceleration produced by either an earthquake on the Whittier-Elsinore fault zone at the upper end of the project or the Newport-Inglewood fault zone at the lower end of the project, is only about 0.0001 during a period of design flow.

In all cases analyzed, the levee cross-sections met or exceeded the minimum required factor of safety of 1.0.

SLOPE PROTECTION

6-08 Revetment stone is required on the unpaved riverside levee slopes. Hydraulic design (see Main Report-Vol. 3) determined the maximum riprap thickness required for the levees will vary considerably as indicated in table D. In areas near drop structures and places of higher velocities, maximum riprap thickness will be as much as 60 inches, with grouted stone proposed as an alternative where riprap thicknesses are excessive. Riprap placed under water would have a 50 percent thicker layer. Grouted stone revetment is proposed to be placed as a 15-inch layer, as a possible alternative to the riprap, throughout the project.

6-09 In order to prevent erosion and loss of fines through the voids in the riprap stone revetment, some type of filter will be required. Two types of filter material were evaluated so that the most economical could be used. The two types are filter stone and filter cloth.

6-10 The stone and filter requirements were designed in accordance with EM 1110-2-1913 and ETL 1110-2-120.

Table D. Riprap/Filter Thickness.

Riprap Thickness			Filter Thickness		
(D50)	(Dry)	(Wet)	(Dry)	(Wet)	
8"	12"	18"	6"	9"	
10"	15"	54"	6"	9"	
12"	18"	27"	6"	9"	
14"	21"	33"	6"	9"	
15"	24"	36"	9"	12"	
24"	36"	54"			
33"	48*	72"			

Drop Structure and Stabilizer Analysis

6-11 In order to maintain the invert grade line, drop structures and invert stabilizers are proposed within the soft bottom reaches of the project. Typical cross sections of the structures are shown in figures 5 and 6.

DESIGN VALUES

6-12 Based on the foundation conditions at the proposed invert structure improvements, the following values are selected for design:

Table E. Invert Structure - Design Values.

Moist unit weight, (pcf)	120
Saturated unit weight, (pcf)	130
Angle of internal friction, (deg)	34
Active earth pressure coef.	0.28
Moist equiv. earth fluid, (pcf)	34
Saturated equiv. earth fluid, (pcf)	80
Passive earth pressure coef.	3.5
Moist equiv. earth fluid, (pcf)	420
Saturated equiv. earth fluid, (pcf)	300
At-rest earth pressure coef.	0.45
Saturated equiv. earth fluid, (pcf)	93
Allowable bearing pressure, (psf)	3000
Permeability,(fpd)	50
Coefficient of sliding friction	0.40

UNDERSEEPAGE

6--13 A drain blanket will be required beneath the proposed drop structures in order to preclude the effects of uplift and piping due to underseepage. Two water surface conditions were considered for this analysis; one for a saturated invert, and another considering full flow conditions. The permeabilities of the foundation materials were based upon the D_{10} of the foundation materials. The uplift forces for both conditions indicated that the saturated invert condition is more critical, and thus is the basis for design. The drain blanket was designed in accordance with ETL 1110--2--236.

STONE PROTECTION

6-14 The hydraulic design has established that the stone requirements for the drop structures, will include derrick stone at the leading and trailing invert areas. The invert stabilizers will be constructed of grouted cobblestone, and will require derrick stone at the trailing invert areas. The gradation requirements for the required stone have been designed in accordance with ETL 1110-2-120, and the filter requirements are in accordance with EM 1110-2-1913.

BEARING

6-15 The existing foundation materials encountered beneath the proposed drop structures will provide a bearing capacity of 3000 psf. Settlement is expected to be negligible for the invert structures, since the additional load due to the improvements is not an appreciable increase from the existing overburden.

LATERAL PRESSURES

6-16 The lateral pressures acting on the breast walls have been determined, assuming that all backfill will be from local required excavation. It has been assumed that drop structure breast wall backfill will remain saturated, and that the driven steel sheetpile wall backfill within the Canyon will drain.

SLIDING

6-17 The coefficient of friction between the base of drop structure slab and the foundation material is assumed to be 2/3 the angle of internal friction of the foundation material.

Concrete Trapezoidal and Rectangular Channel Analysis

DESIGN VALUES

6-18 The soils design values selected for the proposed concrete channel are based on conservative interpretations of the field and laboratory test results. Consideration was given to design values selected for similar material on major projects constructed by the Los Angeles District Corps of Engineers. Permeability of the foundation materials is based on tests performed at 80 and 90 percent of maximum density (ASTM D 1557) on samples representative of lower quartile gradations from frequency studies of all foundation samples taken. The following values are selected for the rectangular channel and for the trapezoidal channel design:

Table F. Concrete Channel Design Values.

ndations	
Allowable Bearing Pressure, (psf)	1500
Permeability, (fpd)	5
kfill .	
Dry Unit Weight, (pcf)	100
Moist Unit Weight, (pcf)	108
Angle of Internal Friction, (deg)	28
Cohesion, (psf)	0
Active Earth Pressure coef.	0.36
Equivalent Earth Fluid Weight, (pcf)	40

SUBDRAIN

6-19 A subdrainage system will be required between 17th Street and Fairview Channel in the Santa Ana River Channel, and in the Greenville-Banning Channel between the San Diego Freeway and Hamilton-Victoria Avenue. A subdrainage system is necessary to control hydrostatic uplift forces under the channel invert and low flow area, due to high groundwater levels or a perched water condition. The subdrain system was designed in accordance with ETL 1110-2-236 and the Los Angeles District Report on Manhole Subdrain System, July 1957. The design was based on channel dimensions given as amended in the Phase II GDM hydraulic design, and an estimated minimum channel invert thickness of 10 inches. A design hydrostatic head of 10 feet above the top of the subdrain collector pipes was used and subdrain pipes were assumed to flow a maximum of 80 percent full. The effect of adjacent subdrains in both the main and Greenville-Banning channels was considered in the subdrain design. Where possible, consistent pipe sizes were maintained along the channel while discharge distances were varied. The design (as discussed in paragraph 7-35) was verified by the construction of full channel flow nets.

LEVEE SLOPE STABILITY

6-20 From Seventeenth Street to about the San Diego Freeway, the channel will be a trapezoidal concrete lined channel. Existing levees will be utilized to some degree. Levee heights, however, will not be increased. The stability of the existing levee materials along the proposed trapezoidal channel reach was checked in accordance with EM 1110-2-1902, as presented in paragraph 6-06.

BEARING

6-21 The bearing capacity of the foundation soils was determined in accordance with EM 1110-2-1903, accounting for both shear and settlement considerations. The allowable foundation bearing pressure of 1500 psf is based on a maximum allowable settlement of 1-inch considering each of the material types encountered in the rectangular channel reach.

LATERAL FORCES

6-22 The lateral earth forces acting on the rectangular wall were determined in accordance with EM 1110-2-2502. The forces were selected assuming that wall deflections will be sufficient to reduce wall pressures to the active state. An active earth pressure coefficient (Ka) of 0.36 and equivalent earth fluid weight (EEF) of 40 pcf are given in paragraph 6-18 with other pertinent design values. These values are based on a cohesionless silty sand (SM) backfill compacted to 90 percent of maximum density (ASTM D 1557).

Disposal Beach Compatibility Analysis

6-23 The analysis of compatibility is based upon the gradations of representative materials obtained from both the disposal (beach) and the borrow (required invert excavation) sites. The gradations of the sampled range lines along the proposed disposal beach have been grouped into composite blends representing similar materials within adjoining sections of beach. The same type of grouping was done for the materials that are to be removed down to the proposed invert within functional construction reaches. The groupings were made so that increased flexibility would be obtained in utilizing all available required invert excavation for the replenishment of adjacent beaches.

COMPATIBILITY CRITERIA

6-24 The criterion for beach fill materials is set within the Code of Federal Regulations, Title 40, Part 230. Specifically, within Section 230.4-1.b.1, the code states that beach restoration materials are to be composed predominately of sand, gravel or shells with particle sizes compatible with the material on disposal beaches.

6-25 The Los Angeles District Corps of Engineers has established quantitative guidelines for the compatibility of beach and borrow materials. The guidelines say that in order to determine compatibility, the grain size distribution curves for the disposal beach samples will be plotted. These curves define an envelope within which all the existing beach material will fall. For the borrow material to be considered compatible, the composite curves for the borrow should fall within the envelope of curves for the disposal beach with the following exceptions. The coarse grained portion of the composite curves may fall outside of the envelope if not restricted by esthetic considerations.

The fine grained portion may also fall outside of the envelope, however, the percentage of silt and clay (percent passing the No. 200 sieve) shall not exceed that of the finest beach sample by more than 10 percentage points.

DISPOSAL BEACH

6-26 Composite gradations for each particular range line were determined using every sample along each range line. The range line gradations are shown in table 11. Range line gradations for similar sections of beach were then compiled, and the average and upper quartile composite and upper limit gradations of the combined areas were plotted. See figure 7 for representative beach gradation envelopes.

INVERT MATERIAL

6-27 All invert areas of required excavation were sampled. The gradation of each sample was obtained and compared with the gradations of adjoining reaches of invert. A composite gradation summary was then developed for functional areas of similar materials, within each reach where excavation is required. See table 9 for representative composite gradations of the invert material to be removed.

COMPATIBILITY

6-28 The Los Angeles District guideline was used to determine grain size compatibility. The average and upper quartile composite and upper limit gradations of one combined section of disposal beach were plotted. The composite average gradation of each representative reach of excavated invert was then plotted on the same figure. Invert materials judged to be generally suitable for beach replenishment are those functional composite groupings that contain up to 10 percentage points more fines than the upper quartile gradation of a section of disposal beach. See figure 7 for the gradation comparisons.

VII. DESIGN APPLICATIONS AND CONSTRUCTION CONSIDERATIONS

Project Dewatering

GENERAL.

7-01 The construction of all levee embankments, invert structures, hard-bottom channel sections will be accomplished free of standing water.

7-02 Dewatering could be accomplished by some combination of drainage ditches, dikes, cofferdams, wellpoints, and pumps or other techniques proposed by the contractor. Each of these methods will be discussed in the following paragraphs. This report also presents a suggested scheme for estimating the dewatering for each typical reach or section.

7-03 The groundwater conditions along the project alignment have been discussed, herein, before. The groundwater basin is illustrated in figures 3 and 4, and groundwater profiles along the project alignment are shown on plate 6.

Diversion

7-04 Surface flow is expected to be continuous along the Lower Santa Ana River, during construction. Generally, water could be diverted to the inactive side of the channel, by means of dikes and drainage ditches. The dikes will be of sufficient height to preclude overtopping, and of sufficient sectional width to eliminate piping. It is recognized that the dike section(s) will be pushed-up and continuously maintained by the contractor, as an area is worked. Any drainage ditch construction, or excavation of dike fill that goes deeper than the final invert elevation will be backfilled and compacted. Overexcavation in reaches of the proposed hard-bottom sections will also be backfilled with compacted fill material.

Groundwater

7-05 Subsurface water may generally be removed by pumping the gravity flow from a sump system, since the foundation materials for this project are typically sand or silty sand. The pumping rates for the preconstruction dewatering of each proposed improvement, will be discussed in the following paragraphs. The rates are discussed as an aid to estimating construction costs. Excessive flows in the cleaner sand foundation materials may be controlled with sheet pile cutoff walls. Seepage into any excavation may be removed by pumping from a sump trench. Based on a 15-foot wide excavation 12 feet deep, a required pumping rate of about 150 gpm per 100 feet of excavation can be expected. A sheet pile cutoff around the excavation could be used to reduce the seepage rate. A cutoff to a depth of 10 feet below the bottom of the excavation would reduce the required pumping rate to about 70 gpm per 100 feet of excavation.

Cofferdams

7-06 Tidal variations within the lower reach of the Santa Ana River will create additional dewatering requirements. The tide is expected to rise as high as +8 feet MLLW (+10 feet NGVD), meaning that tidal surface flows could effect construction as far inland as Adams Avenue. Cofferdams may be used to control the upstream movement of the tides.

Levee Construction

NEW CONSTRUCTION

7-07 New construction will consist of building new levees to the alignment and elevations required by the hydraulic design where existing levees cannot be modified or do not currently exist. Paragraph 7-12 discusses the proposed levee modifications, including widening or raising existing levees as described in paragraphs 1-13 through 1-24. Closely related construction in the channel, including stabilizers and drop structures and channel excavation, are discussed in the following paragraphs 7-22 through 7-40.

Geometry

7-08 The new levees would be constructed with 1V on 2H side slopes and a top width of not less than 15 feet. Typical dimensions and cross sections are shown on plates 29 to 37.

Foundation Treatment

7-09 The foundation areas for new levee construction would be cleared and grubbed to expose the foundation soils, and proof-rolled to at least 90 percent of maximum density (ASTM 1557) to provide a firm foundation for the compacted fill materials and to reduce underseepage and settlement. Control of surface water in the channel can be accomplished

with diversion levees to direct the flows to the opposite side of the channel, however dewatering may still be required in some areas to allow excavation and construction of the levee toe. Dewatering could be accomplished with a system of well points or a collection ditch with sump pumps. Temporary excavation slopes for the toe construction would be no steeper than 4V on 3H, and in areas of relatively loose noncohesive granular soils, may need to be flatter. The required excavation for toe construction will preclude the need for the excavation of a separate inspection trench. Unsuitable foundation soils such as soft clays, loose sands or open-graded gravel or cobble layers would be removed and recompacted or replaced with compacted levee fill materials.

Sources of Material

7-10 The new levees will be constructed with materials from the required channel invert excavation. Hydraulic design of the channel requires the lowering of the existing invert elevation at various locations. The two locations within reasonable haul distances that could provide suitable materials from the required excavation are in reach 1, above Imperial Highway, and just downstream of reach 4 between Seventeenth Street and Edinger Avenue. The materials available in the upper borrow area are primarily sands with relatively small amounts of silt and gravel, as described in paragraphs 5-01 through 5-10. The materials available in the lower borrow area are finer grained, primarily silty and clayey sands with occasional gravels and cobbles, as described in paragraphs 5-19 through 5-22. The balance factors for materials from either borrow site would be approximately 0.85 when excavated, hauled, placed, and compacted with conventional construction techniques. The relatively pervious granular materials from the upper borrow area are preferred due to their ease of handling and free-draining characteristics. Excess pore pressures and marginal slope stability under sudden drawdown conditions would be largely eliminated if these materials are used to construct the new levee sections. Finer-grained, slower-draining materials from the lower borrow area would reduce the hauling distance and costs for the levees in reaches 3 and 4, but would probably increase the potential for slope distress during the life of the project. A discussion of the stone and filter materials to be used on the levees is presented in paragraphs 7-17 through 7-21.

Construction Requirements

7-11 Conventional heavy construction equipment would be suitable for construction of the levees. Excavation of the borrow materials from the channel invert could be accomplished with self-propelled scrapers if the haul distance is reasonably close, or with rubber-tired loaders and hauled in off-road trucks if haul distances are longer. After clearing, grubbing and proof-rolling the foundation, borrow materials from the channel invert excavation would be placed and spread in lifts no thicker than one foot. Cobbles and boulders larger than 3/4 of the lift thickness would be removed on grade before compaction. Processing of the excavated materials to remove the oversize particles would not be

required due to the relatively small amount of stone in the borrowed areas. Moisture content of the fill materials would be adjusted to near optimum by adding water on grade if too dry, or by scarifying and aerating if too wet. The conditioned fill material would then be compacted to at least 90 percent of maximum density as determined by ASTM D 1557 by rolling with a rubber-tired or other type roller suited to the materials being compacted. Field density tests (ASTM 1556) would be conducted in sufficient numbers to assure that the required compaction is accomplished. Slope protection requirements are discussed in paragraphs 7-17 through 7-21.

RECONSTRUCTION

7-12 The existing levees would be modified in some locations by increasing the height of the levee or by a realignment of the centerline.

Geometry

7-13 The modified levees would be constructed with 1V on 2H side slopes and a top width of not less than 15 feet, the same as the new levee sections. Typical sections showing the variations and extent of levee modification are shown on plates 29 through 36.

Foundation Treatment

7-14 Where new fill material is to be placed over existing levees, the levee will be prepared as a suitable foundation by removing any pavement on the crest and any slope protection or vegetation on the side slopes. Sloped surfaces steeper than 1V on 4H will be flattened or stepped so that the compaction equipment will bear fully, and proof-rolled to at least 90 percent of maximum density as determined by ASTM test method D 1557. New foundation areas will be cleared grubbed, proof-rolled, and scarified before the first lift is placed. As with the new levee construction, dewatering may be required in some areas where the riverside slope of the existing levee is to be modified.

Sources of Material

7-15 Borrow materials for modification of the existing levees will be obtained from the same channel excavation sources as for the new levee construction. Free draining granular materials will be available within all the construction reaches of the project.

Construction Requirements

7-16 Reconstruction of the existing levees can be accomplished with conventional heavy construction equipment following the same procedures described for new levee construction, except that the existing slope protection would be removed and stockpiled if adequate for reuse.

SLOPE PROTECTION

Stone Sources

7-17 Slope protection materials for the Lower Santa Ana River project would be available from two sources, nearby commercial rock quarries and portions of the existing river levees. Local quarries which have produced suitable stone within the past 5 years for Corps of Engineers' construction projects are listed in table G. All these sources are within 30 miles of either the upstream limits (Santa Ana Canyon) or downstream limits (Pacific Ocean) of stone placement for the project. The Corona group of quarries (Corona-Pacific, Harlow and 3M) would be the closest sources to the upper reaches of the project. Stone could also be obtained from the more distant Atkinson, Declezville and Stringfellow operations in the Jurupa Mountains near Riverside. The Slover Mountain Quarry near Colton and the Fish Canyon Quarry near Azusa would also be potential sources of stone. The closest source to the downstream limits of the project is the Pebbly Beach (Connolly-Pacific) Quarry on Santa Catalina Island.

Table G. Rock Quarry Locations.

Quarry	Nearest City	inimum Distance to Site (mi)
Atkinson	Riverside	18
Corona-Pacific	Corona	9
Declezville	South Fontana	18
Fish Canyon	Azusa	22
Harlow	Corona .	11
Pebbly Beach	Avalon (Santa Catalina Is.)	30
Slover Mountain	Colton	24
Stringfellow	Riverside	18
3M	Corona	10

During construction, suitable stone may also be reclaimed from portions of the existing levees (see paragraph 5-14). Reach 3 from Katella Avenue to Santiago Creek would provide stone suitable for reuse as slope protection. Armor stone currently in place on the existing jetties could be utilized in the jetty reconstruction.

Stone Quality

7-18 Results of recent quality compliance tests conducted by SPD laboratory on stone samples from the quarries listed in table G and from the existing levees are summarized in table 10. In addition, the most recent Corps of Engineers project associated with each quarry source is

shown. Although the quarries listed in table 10 have provided suitable stone for Corps projects in the past, restrictions were placed on recent usage of stone from the Harlow Quarry near Corona. Stone from this source was accepted for use only as grouted stone in the Warm Creek-Santa Ana River Confluence project because of the breakdown which occurred during the June 1985 wetting and drying test. Despite high abrasion losses shown for the Pebbly Beach and Declezville quarries, and a sulfate soundness loss much greater than the specified limit of 10 percent for the Pebbly Beach source, stone from both quarries has previously been accepted for use on Corps projects based on proven satisfactory service records. Stone from Declezville was placed in the San Pedro Breakwater, completed in 1912, and has shown no appreciable deterioration since that time. Stone from Pebbly Beach, despite its heterogeneous character, has given good service in the Long Beach and Middle Breakwaters, beginning in the mid-1930's.

7-19 Results of quality compliance tests conducted in February 1988 on samples of the existing levee riprap indicate an overall improvement in rock quality between reaches 1 and 3 (see table 10). However, the test results do not accurately reflect the deteriorating physical condition of the volcanic andesite rock in reaches 1 and 2. Although the rock types common to each reach passed the wetting and drying tests, the andesite, which is diagnostic of Harlow Quarry, has demonstrated an unsatisfactory service record because of its tendency to breakdown along incipient fractures. This fact in itself would make the riprap on the existing levees between Weir Canyon Road and Katella Avenue unsuitable for reuse as slope protection and might preclude or restrict the use of stone from Harlow Quarry on the project.

Stone Assessment

7-20 More than one source may be required to supply the estimated 500,000 plus cubic yards of riprap required for the Lower Santa Ana River project. Suitable stone may be available form additional quarries in the Riverside-Corona area or from other locations, but information on these potential sources is not included in table 10 due to lack of either recent test data or service records on Corps projects. Although the majority of the sources have produced acceptable stone in the past, it cannot be assumed that they will continue to do so. Therefore, any stone source considered for use as slope protection will require further field inspection and evaluation, and may require additional quality compliance testing prior to stone placement.

Revetment

7-21 Stone revetment meeting the gradation requirements as analyzed in paragraph 6-08 can be placed with conventional methods from either the top or bottom of the levee. Care must be taken during placement to prevent segregation and unnecessary displacement of the underlying filter or bedding layers. Riprap stone gradations, for each dry thickness presented in the hydraulic design, are as follows:

Table H. Riprap Gradations.

Riprap - 12" thickness

Approximate Weight of Individual Pieces (1bs)	Percent Passing (by weight)		
86	100		
35	65-100		
26	50-70		
17	15 - 50		
5	0-15		

Riprap - 15" thickness

Approximate Weight of Individual Pieces (lbs)	Percent Passing (by weight)		
169	100		
67	65-100		
50	50 -7 0		
34	15-50		
11	0-15		

Riprap - 18" thickness

Approximate Weight of Individual Pieces (1bs)	Percent Passing (by weight)
292	100
117	65-100
86	50-70
58	15-50
18	0-15

Riprap - 21" thickness

Approximate Weight of Individual Pieces (lbs)	Percent Passing (by weight)		
463	100		
185	65~100		
137	50-70		
93	15-50		
29	0-15		

Riprap - 24" thickness

Approximate Weight of Individual Pieces (1bs)	Percent Passing (by weight)		
691	100		
276	65-100		
205	50 - 70		
138	15-50		
43	0-15		

Riprap - 36" thickness

Approximate Weight of Individual Pieces (lbs)	Percent Passing (by weight)		
2333	100		
933	65-100		
691	50-70		
467	15-50		
146	0-15		

Riprap - 48" thickness

Approximate Weight of Individual Pieces (lbs)	Percent Passing (by weight)
5520	100
2200	65-100
1647	50-70
1111	15~50
350	. 0-15

Filter Stone

7-22 Layers of filter stone can be placed with conventional construction methods. Recommendations for filter stone are as follows:

- 1. The layer thickness of filter stone will be in accordance with the table presented in subparagraph 6-08.
- 2. Filter fabric is an alternative to filter stone in areas where dewatering is a concern, since placing filter stone under water could cause segregation. If filter stone is placed under water, a 50 percent thicker layer should be used.
- 3. Filter fabric will be used in the higher energy revetment sections downstream of Pacific Coast Highway in order to eliminate both segregation concerns and multiple layer costs.

4. The filter stone gradation of the 12-, 15-, 18-, 21- and 24-inch thick riprap stone follows:

Table I. Filter Stone Gradation.

Sieve Size	Percent Finer (by weight)
3 inch	100
1-1/2 inch	65-100
1 inch	50 – 85
1/2 inch	15-50
No. 4	0-15

7-23 Filter fabric will have an equivalent opening size (EOS) of 70 and should be nonwoven to prevent tearing. A 15 percent increase in slope area should be considered in estimating filter fabric requirements, to consider the effects of lapping and bunching. Filter fabric would need to be anchored at the top and the bottom, and protected from puncture with an overlying layer of crushed rock. The top and bottom can be anchored in narrow trenches at the top and bottom of the levee by placing the edge of the fabric in the trench and backfilling with soil. A 6-inch thick (9-inch when placed in wet) layer of crushed rock or sandy streambed materials on top of the fabric would cushion the fabric from the impact of larger stones during the placement of the revetment. Steambed materials would be placed with a controlled drop height not to exceed 12-inches, and would not be used as bedding in higher energy areas (i.e., when dry riprap thicknesses exceed 24-inches). Splicing segments of filter together in the field would be in accordance with the manufacturer's recommendations.

Grouted Stone

7-24 Stone to be grouted can be placed with the same methods and equipment used to place stone revetment. No filter layer would be required beneath the grouted stone. If groundwater is present near the surface, dewatering of the toe excavation may be necessary to carry out the grouting operation. For estimating purposes, the volume of grout may be expected to be about 30 percent of the calculated volume of the grouted stone layer. For a 15-inch layer of grouted stone, the stone would be well graded and vary in size from 3 to 12-inches in diameter.

Drop Structure and Stabilizer Construction

REQUIRED EXCAVATION

7-25 The proposed invert structures will be founded on the native invert materials. The invert will be excavated to an average depth of about 5 feet for invert stabilizer construction, and 10 feet for the construction of the drop structures. Temporary slopes will not be steeper than 4V on 3H.

7-26 The excavation will be kept free of standing water during construction. Any surface flows will be diverted around the construction area by means of temporary dikes. Seepage into the excavation will be removed by means of pumping from sumps. The pumping rate to dewater the drop structure excavations is conservatively estimated to be not more than 200 gpm, based upon an open excavation of half the channel width. Dewatering rates for the invert stabilizer excavations would be less than half of that for the drop structures.

FOUNDATION PREPARATION AND BACKFILL

7-27 The foundation subgrade surface will be trimmed and proof-rolled to a smooth and uniform grade prior to any structural improvement.

7-28 The backfill and fill materials will be selected from the required excavation. Materials with greater than 20 percent fines should not be used as backfill for the breast walls. The backfill will be placed in 1-foot lifts and will be compacted to not less than 90 percent of maximum density as determined by ASTM method D 1557. Fill materials will be placed on surfaces that have been cleared and scarified to a depth of 6 inches. Sloped ground surfaces steeper than one vertical to 4 horizontal will be flattened or stepped so that the compaction equipment will bear fully on the fill layer. The fill will be compacted to not less than 95 percent of maximum density.

GEOMETRY

Invert Structure Stone

7-29 The invert structure stone will be placed to the dimensions shown in figures 5 and 6. The stone will be graded as presented in following table. Grouted stone will be placed in a uniform mass in order to eliminate double decking or layering of the stone.

Table J. Invert Structure Stone Gradations.

Gravel Drain(1-1/2 inch crushed rock)

Sieve Size	Percent finer (by weight)
1-1/2 inch	100
1 inch	90-100
3/4 inch	55-90
3/8 inch	8-20
No. 4	´ 0 - 5

Bedding Stone

Weight of individual Pieces (Pounds)	Percent Finer (by weight)
85	100
35	65-100
15	15-50
5	0-15

Derrick Stone

7-30 The derrick stone will be approximately 36 inches in diameter, will extend 30 feet upstream and downstream of the structure. On the downstream portion, the stone will slope downward at a 1V on 2H slope. The thickness of the derrick stone will be 5 feet with 2 feet of bedding stone, a layer of filter fabric, and 6 inches of bedding sand (raked, native material, 3-inch material) beneath the derrick stone layer.

Grouted Stone

7-31 The grouted cobblestone will be reasonably well graded between 3 and 12 inches.

Drain Blanket

7-32 The gravel drain material and 6-inch collector drain pipe will be placed to the dimensions shown in figure 5. Additionally, 3-inch weep holes, 10-foot on center, will drain the breast wall backfill. The gravel drain material will be graded as presented in the previous table. Segregation and contamination of the drain materials will be avoided. The gravel drain material will lie over a filter fabric and 6 inches of native invert materials which have been raked of +3-inch material. The grouted stone drop structure will have 3-inch diameter horizontal weepholes spaced at 10 feet on center and will be placed one foot above the elevation of the end sill. Each weephole will be backed with a one cubic foot gravel drain pocket completely bound by filter fabric. The interface between the gravel pocket and the grouted stone will be separated by a 12-inch by 12-inch section of galvanized wire mesh (1/4 inch openings). The gravel drain material will be 1-1/2-inch crushed rock as shown in table J.

Levee Facing

7-33 To preclude the possibility of piping around the invert structures, the grouted stone levee facing should extend not less than 5 feet below the deepest portion of grouted facing stone of the invert stabilizers, or 10 feet below the bottom of the base slab of the drop structure.

SANTA ANA CANYON SHEETPILE

7-34 At the drop structure, improvements will consist of extending the steel sheetpile wall 23 feet deep on both sides of the river down to an elevation of 435 feet. Materials in this drop structure area should not be a problem for standard sheetpile driving procedures.

Concrete Channel Construction

CHANNEL EXCAVATION

7-35 From Seventeenth Street to Fairview Channel, the proposed concrete channel will be founded on native soil and will be constructed by open cut. The invert will be excavated up to a depth of 5 feet below the existing streambed surface. Invert materials are generally medium dense poorly graded sands and silty sands. In addition to the invert excavation, it will be necessary to cut into some existing levees for construction of the channel walls and new levee slopes. Temporary slopes will not be steeper than 4V on 3H.

7-36 The excavation will be kept free of standing water during construction. Surface flows will be diverted around the active construction area by means of temporary earth dikes, and seepage into the excavation will be controlled by means of pumping from sumps. Based on an open excavation of half the channel width and 5 feet deep, the pumping rate required to dewater the excavation is about 100 gpm per 100 feet of channel.

FOUNDATION PREPARATION

7-37 In areas where the proposed channel invert is below the existing streambed, the subgrade will be excavated to the design grade, approximately 1 foot below the bottom of invert slab-elevation, then trimmed to a uniform grade. The subgrade will then be proofrolled to 95 percent of maximum density (ASTM D 1557) so that no stone protrudes more than 3 inches above grade. Any soft or yielding materials encountered would be removed, backfilled with select material, and recompacted to 95 percent of maximum density (ASTM D 1557). Where the proposed channel invert is above the existing streambed, fill material from the required excavation will be placed on the existing grade in compacted lifts no thicker than 12 inches. Lifts will be built up to the design grade elevation and will be compacted to at least 95 percent of maximum density (ASTM D 1557). To prevent hydrostatic uplift of the fill and paved invert, fill material placed beneath the invert will contain not more than 15 percent fines.

SUBDRAIN CONSTRUCTION

7-38 The subdrainage system in the Santa Ana River Channel will be constructed in three configurations, and a fourth configuration will be constructed in the Greenville-Banning Channel. Each configuration will include a 6-inch gravel drain layer placed between a 6-inch thick layer of filter sand and the concrete channel invert. The subdrainage system

for the downstream end of the rectangular channel will consist of an 8-inch diameter collector (perforated) pipe placed longitudinally behind either channel wall and two 6-inch diameter collector pipes placed longitudinally under each half of the invert slab at 50 foot spacings, starting from the channel wall collector. A final or third 6-inch diameter collector pipe will be placed adjacent to either side of the low flow channel, inset 60 feet from the previous invert collector. The system for the upstream (narrower) portion of the rectangular channel will be the same but with one less collector pipe and constant 50 feet spacing. The subdrainage system for the trapezoidal channel will consist of three 6-inch diameter collector pipes placed longitudinally under each side of the invert slab. The first collector will be under the outer edge of the invert, the second will be inset 30 feet, and the final pipe will be inset 40 additional feet. The drain and filter materials will extend up, beneath the channel slope paving, 5 feet above the invert. The subdrainage system for the Greenville-Banning Channel will consist of one 10-inch diameter collector pipe behind either side of the channel just above the base of the channel walls.

7-39 The collector pipes under the invert slab will empty into 10-inch diameter nonperforated discharge pipes. The nonperforated pipes will be spaced at 300 feet for the lower portion of the rectangular channel, 400 feet for the upper portion of the rectangular channel, and 600 feet for the trapezoidal channel. The collector pipes behind the rectangular channel L-walls will discharge directly through a flap gate in the channel wall. Flap gates in the channel walls will be spaced at 500 feet for the lower portion of the rectangular channel, and 600 feet for the upper portion of the rectangular channel. Flap gates in the Greenville-Banning channel walls will be spaced at 300 feet for the rectangular channel and 600 feet for the trapezoidal channel.

7-40 The design configuration plates for the subdrain systems are presented within the Main Report-Vol. 3.

7-41 The filter and gravel drain materials will be graded between the standard limits specified below:

Table K. Subdrain Stone Gradations.

Filter Material (Washed Concrete Sand)

Percent Finer (by weight)
100
80-100
50-85
25-60
10-30
2-10

Gravel Drain (1-1/2 inch crushed rock)

1-1/2 inch	100
1 inch	90-100
3/4 inch	55 - 90
3.8 inch	8-20
No. 4	0-5

Care will be taken to avoid contamination or segregation of the sand filter and gravel drain materials during placement. Precautions, such as use of light equipment, will be employed to ensure uncontaminated layers of the required thickness.

EMBANKMENT CONSTRUCTION

7-42 The existing left and right levees of the Santa Ana River Channel that will be paved as a trapezoidal section may be either cut back or built out, depending on the location, in order to create the new channel alignment. Conventional heavy construction equipment will be suitable for excavation of existing levees and construction of new levee fills. Fill materials will come from the required levee and invert excavation. Excavation of the borrow materials may be accomplished with self-propelled scrapers for short haul distances or with rubber-tired loaders and hauled in trucks for long haul distances. Levee fill will be placed in compacted lifts no thicker than 12 inches. Fill will contain no particles greater than 9 inches and will be compacted to 90 percent of maximum density (ASTM D 1557). Where new fill material is placed over existing levees, the levee will be prepared as a suitable foundation by removing any pavement or vegetation and flattening or stepping slopes steeper than 1V on 4H so that compaction equipment will bear fully on the compacted layer.

BACKFILL

7-43 Structural backfill behind the rectangular channel L-walls will consist of select material from the required excavation. Backfill materials will consist of sands and silty sands containing no particles larger than 3/4 of the compaction lift thickness and no more than 10 percent passing the #200 sieve. Backfill will be placed in 12-inch thick loose lifts and compacted to not less than 90 percent of maximum density (ASTM D 1557) and within 2 percent of optimum moisture content. Compaction of backfill material will be accomplished by means which do not overstress the L-wall. Mechanical hand tampers may be employed, but heavy equipment will not be permitted within 3 feet of the wall.

Beach Disposal

ACCEPTABLE INVERT EXCAVATION

7-44 The acceptable invert materials for beaches are shown in the figure 7 series of compatibility envelopes, as described in paragraph 6-28. Acceptable materials have been identified only to the depth of the proposed invert. All composite areas of required invert excavation (see table 9) are useable for beach placement. Because it vert materials are subject to change during periods of significant channel flow, the suitability of any required excavation designated for placement on the beach should be monitored during construction. Acceptable materials are identified only by grain size in this appendix.

PLACEMENT

7-45 The method of placing renourishment materials on a beach is a critical factor in retaining the materials. Specific methods of placement and geometry will be presented in the Coastal Design Appendix.

VIII. CONCRETE MATERIALS

GENERAL.

8-01 This section discusses the availability and suitability of concrete materials. Prior to the preparation of plans and specifications, a detailed concrete materials investigation will be prepared for the concrete structures. The scope of the investigation will be in accordance with the requirements of EM 1110-2-2000, Standard Practice for Concrete, dated 5 September 1985.

Aggregate Sources

GENERAL

8-02 The following paragraphs summarize the potential sources of concrete materials available for the project. The material sources listed are representative of those currently used by the local producers. Plate 39 shows the locations of aggregate, cement, and pozzolan sources. Detailed investigations, which evaluate the quality of the aggregates from those sources are in progress. Additional sources will be investigated and the complete analysis of the results will be presented in the Feature Design Memorandum addressing major items of concrete construction.

BLUE DIAMOND MATERIALS

8-03 This producer of concrete aggregate is located on an alluvial sand and gravel deposit along the Santiago Creek in Irvine, CA. Blue Diamond has been at this location for 12 years and expects to be in production there for a minimum of 8 more. The plant produces 1-1/2" aggregate, 3/8" pea gravel, and washed concrete sand. Additionally, the plant produces 3/4", 1/2", and 3/8" crushed rock as well as some boulders of up to three foot diameter. The plant has an annual output of approximately one million tons and is located 28 miles from the Santa Ana River at both Prado Dam and its juncture with Pacific Coast Highway.

FOSTER SAND AND GRAVEL

8-04 Foster Sand and Gravel is located along Temescal Wash near Corona, California, and consists of an alluvial sand deposit. Foster has been at this location since 1972 and expects to be in production there for a minimum of 25 more years. The plant produces chiefly sand for fine aggregate although about 15 percent of its output consists of 1 inch aggregate and 3/8 inch pea gravel. The plant has an annual output of approximately one million tons and is located 15 miles from the Santa Ana River at Prado Dam and 45 miles from the river at Pacific Coast Highway. Located in the immediate vicinity of Foster are several other producers of sand for use in concrete including R.J. Noble, Chandler, Concrete Products Inc., and C.L. Pharris.

OWL ROCK

8-05 The Owl Rock Plant in Rialto has been located along Lytle Creek since 1955 and expects to be in production there for a minimum of 80 more years. The site consists of an alluvial deposit and produces 1-1/2 inch and 1 inch aggregate, 3/8 inch pea gravel, and washed concrete sand. The plant has an annual output of almost two million tons and is located 30 miles from the Santa Ana River at Prado Dam and 60 miles from the river at Pacific Coast Highway. While this source is not located in the immediate vicinity of the project area it is included here because it supplies aggregate to many ready mix firms which are in the project area.

TRANSIT MIXED CONCRETE

8-06 Transit Mixed Concrete mines a deposit along the San Gabriel River in Azusa, CA which is alluvial in nature. Transit Mixed has been at this location for over 40 years and expects to be in production there for a minimum of 15 more years. The plant produces 1-1/2 inch and 1 inch aggregate, 3/8 inch pea gravel, and washed concrete sand and has an annual output of over three million tons. It is located 25 miles from the Santa Ana River at Prado Dam and approximately 45 miles from the river at Pacific Coast Highway. Located in the immediate vicinity of Transit Mixed are several other aggregate producers including Blue Diamond Materials and Cal Mat.

Cementitious Materials

CEMENT SOURCES

8-07 There are a relatively wide variety of cement producers in and near the Los Angeles Basin which are capable of supplying cement certified by the Corps of Engineers ongoing cement certification program. Among these plants are the California Portland Cement Company plant at Colton, the Kaiser Cement Company plant at Lucerne Valley, the

Southwestern Cement Company plant at Victorville, and the Riverside Cement Company plant at Riverside. All of these plants are in the state of Califorina. The following paragraphs summarize the types of cements which these plants produce. Table L supplies prices of various cements from the sources specified, and Table M contains cost data on the shipping of cement.

8-08 The California Portland Cement Company plant at Colton, located approximately 25 miles north of Prado Dam and 55 miles north of the Santa Ana River's juncture with the Pacific Coast Highway, produces Type II and III cements conforming to the requirements of ASTM C-150.

8-09 The Kaiser Cement Company plant in the Lucerne Valley, located approximately 89 miles north of Prado Dam and 119 miles north of the Santa Ana River's juncture with the Pacific Coast Highway, produces Type II cement conforming to the requirements of ASTM C-150. This plant also produces a blended cement conforming to the requirements of ASTM C-595, Type IP.

8-10 The Riverside Cement Company plant at Riverside, California, located approximately 17 miles west of Prado Dam and 47 miles northeast of the Santa Ana River's juncture with the Pacific Coast Highway, produces Type II cement conforming to the requirements of ASTM C-150.

8-11 The Southwest Cement Company plant at Victorville, California, located approximately 66 miles north of Prado Dam and 96 miles north of the Santa Ana River's juncture with the Pacific Coast Highway, produces Type II and V cements conforming to the requirements of ASTM C-150.

Table L. Cement Prices in Dollars Per Ton. (FOB Plant, December 1987)

		Cement	Туре	
Cement Plant and Location	IP	II	III	V
California Portland, Colton		73.00	78.00	_
Kaiser, Lucerne Valley	74.30	60.00	~	-
	-	64.00	-	80.30
Southwestern, Victorville				

Table M. Cement Shipping Prices in Dollars Per Ton. (December 1987)

Distance (Miles)	Cost	Distance (Miles)	Cost	Distance (Miles)	Cost
3-5	3.142	30-35	4.480	70-80	7.828
5-10	3.296	35-40	5.200	80-90	8.446
10-15	3.450	40-45	5.922	90-100	9.012
15-20	3.760	45-50	6.386	100-110	9.682
20-25	3.966	50-60	6.902	110-120	10.300
25-30	4.224	60-70	7.314	120-130	11.072

POZZOLAN SOURCE

8-12 ETL 1110-1-127, dated 17 August 1984 requires the Federal Government to allow the use of flyash in concrete construction except in those cases where it's use can be proven to be undesirable. The local practice of the ready-mix concrete industry is to use flyashes as pozzolanic admixtures in concrete. The reasons for this is the reduction of heat of hydration, reduction in cost due to the price of flyashes in comparison to the price of cement, increased workability at lower water contents, and the reduction in the alkali-aggregate reaction. The practice of local agencies is to specify Type F flyash generally conforming to the requirements of ASTM C-618. The Corps of Engineers has recently started a program to evaluate the quality and uniformity of flyashes and has set up a certification plan, for flyashes, similar to the one used for cements. Materials conforming to these requirements are produced at the plants shown on plate 39.

8-13 The closest local producer, the Western Ash Company, supplies flyash, conforming to the requirements of ASTM C-618, Type F, from a plant at Page, Arizona, approximately 555 miles northeast of Prado Dam and 585 miles northwest of the juncture of the Santa Ana River and Pacific Coast Highway.

Admixtures

8-14 A wide variety of admixtures are regularly used by ready-mix concrete suppliers in southern California. These include all of the following: air entraining agents, accelerators, retarders, water reducers and high range water reducers. The relatively common methods anticipated for construction of the strutures described above should not require any specialty admixtures other than those recommended in the section: Recommendations.

Water

8-15 Water of sufficient quantity and suitable quality for the production of concrete will be available from local municipal water systems.

Curing Compounds

8-16 A wide variety of curing compounds are available for use from the aggregate suppliers to the local ready-mix concrete industry. Curing compounds will be specified in accordance with project requirements and ASTM C-309.

Transit Mixed Concrete

8-17 Commercial ready mixed concrete plants are located within competitive hauling distances of all sections of the Santa Ana River downstream of Prado Dam. As of December, 1987 the approximate cost of a cubic yard of concrete in the project area is \$60.

Recommendations

AGGREGATES

8-18 Aggregates suitable for the production of concrete are produced at the sources previously discussed. These sources are capable of supplying sufficient amounts of aggregates to meet the needs of this project. All aggregates used shall conform to the requirements of ASTM C 33. Coarse aggregate gradations should be 1-1/2 x 3/4, 1 x No. 4 as described in CALTRANS specifications, or should be size No. 467, No. 57, or No. 67 as described in ASTM C 33, as required by the design/engineer. All aggregate used shall conform to the requirements of ACI 350 and ASTM C 33 with the following limitations.

- a. Soft particles: 2.0 percent.
- b. Chert as a soft impurity (defined in Table 3 of ASTM C 33):1.0 percent.
- c. Total of soft particles and chert as a soft impurity:2.0 percent.
- flat and elongated particles (long dimension more than 5 times short dimension): 15 percent.
- e. Maximum aggregate size shall not exceed 1-1/2 inches, except where structural or other considerations require a difference.

CEMENTS

- 8-19 The following cements and requirements will be specified.
 - a. Cement would be Type II, low alkali (0.6 percent maximum), conforming to the requirements of ASTM C-150.
 - b. Blended cements would conform to the requirements of ASTM C-595, Type IP.
 - c. For applications in which high early strengths would be desired due to construction scheduling, ASTM C-150, Type III cement would be acceptable.

POZZOLANS

8-20 The only pozzolanic materials generally in use locally are type F flyashes conforming to the requirements of ASTM C-618. Specifications will call for flyashes conforming to the requirements of ASTM C-618, Type F, with the loss in ignition limited to 6 percent.

ADMIXTURES

8-21 Construction of the structures described above involve relatively simple construction procedures. The necessity for sophisticated admixtures is not anticipated. However, calcium chloride wil not be permitted to be added for reinforced concrete because of the deleterious effect it may create by accelerating the corrosion of the reinforcing steel and concrete (ACI 201). The following types of admixtures will be specified in all construction.

Air Entraining Admixtures

8-22 If air-entrained admixtures are used, they would conform to the requirements of ASTM C-260.

Accelerating Admixtures

8-23 Accelerating admixtures will conform to the requirements of ASTM C-494, Type C, except that no calcium chloride will be allowed in reinforced concrete.

Retarding Admixtures

8-24 Retarding admixtures will conform to the requirements of ASTM C-494, Type B or D.

Water Reducing Admixtures

8-25 Water reducing admixtures will conform to the requirements of ASTM C-494. Type A or D.

MIX PROPORTIONING

8-26 All materials used should be so proportioned as to produce a well graded mixture of high density and maximum workability, with a specified 28-day compressive strength of 3500 psi (ACI 350), except where special structural or other considerations require concrete of greater strength. The water-cement ratio should be limited to .45 maximum (ACI 211), thus producing a very dense and low permeable concrete. Slump in the range of 1 to 3 inches is recommended for workability.

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A GEOTECHNICAL

TABLES

TABLE 1
LOWER SAWTA ANA RIVER: WEIR CANYON ROAD TO PACIFIC OCEAN

					****	EXISTING	CHANNEL	CONDITIONS	***** SN		
REACH STATION FROM	10 M 10 M	LANDARR (STATION)	ORANGE COUNTY DRAWING NUMBER	CHANNEL BASE WIDTH (ft.)	LEVEE BERM WIDTH (ft.)	LEVEE HEIGHT (ft.)	INSIDE SIDE SLOPE (H: 1V)	OUTSIDE SIDE SLOPE (H:1V)	HEIGHT OF UNPRTECTD TOP OF LEVEE (ft.)	SLOPE PROTEC- TION	TIPE AND DEPTH OF TOE PROT-
REACH 1						-~-			 -		
1220+00 1207+63	1207+63	•	B01-701-8	varies		12-22				70	
1207+63 1204+75	1204+75		B01-701-8 & B01-101-26	varies	8	13-22	~	~~~		stone w/ 1 8" filter 1	stn + 3' drrck stn
1204+75 1198+08	1198+08	WEIR CIN. RD. (1202+00) H.W.D. OUTLET (1200+50)	E01-701-8 # 1 E01-101-4-A# 1 E01-101-26	340-320	8,38	13-21	~	~~~~	5,	2-4' facing stone w/ 6-8" filter	6-11' fcg stn + 3' drrck stn
1198408 1197460	1197+60	DROP STRUCTURE (1198+07)		330	8	22-14			0	8" R.C.	conc invert
1197460 1196407	1196407	at the fire	101-101-101 101-101-1-101	315	R 8	18.2-22			~	18-36" grtdi fcg stone w/1 6" filter	6' facing
1196407 1174400	1174+00			varies	 8	18-18.5			2	18" fcg stnf w/ 6" fltr i	stone + 3' derrick stone
1174+00 1148+50	1148+50		1 1 1501-701-8 & 1	 %	20,21	17.5-18			0,2		
1148+50 1129+50	1129+50		E01-501-1-AE	390-295	20,21	14.5-17.51				••••	11-13' fog 1 gtn + 3'
1129+50 1128+70	1128+70	STABILIZER (1129+40)	B01-101-4-A		20,21	14.5,15.51				24,18" [facing stone w/	grid stone
1128+70 1110+00	1110+00	in the Sta		 &	20,21	14.5-17				oun ritter	11-13' fog 1 stn + 3' 1 drrck stn 1
1110+00 1072+70	1074+70		E01-501-1-A# 1	8	20,21	12-14			0,2	-	6' facing
1074+70	1074+70 1056+00	IMPERIAL HWY. (1057+50)	B01-501-1-A	<u> </u>	~	22	~	~	0	24" fog stni w/ 6" fitr	<u>~</u>
		•			•		•	•	•		

TABLE 1 (cont.)

Name						京 · · · · · · · · · · · · · · · · · · ·	EXISTING	CHANNEL	CONDITIONS	***** S		
Particular (STATION) Property	REA	2		ORANGE	CHANNEL	LEVEE	gana i	INSIDE	OUTSIDE	HEIGHT OF UNPRIECTO	SLOPE	TYPE AND DEPTH OF
99 BROP STRUCTURE (1022-98) BD1-101-0-4 BO 21,24 13,7-15,12 2 1 1 22,7 facing and a proper STRUCTURE (1022-98) BD1-101-0-4 BO 21,24 13,7-15,12 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 13,7-15,12 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 13,7-15,12 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 13,7-15,12 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 13,7-15,12 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 13,7-15,12 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 13,7-15,12 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 13,7-15,12 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 13,7-15,12 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,16 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,19 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,19 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,19 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,19 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,19 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,19 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 4,19 filter 20 BD1-101-0-4 BO 22, 14,19 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	STAT	10H 75	LANDARR (STATION)	DRAVING	WIDTH (ft.)	MIDTH (ft.)	HEIGHT (ft.)	SLOPE SLOPE (H: 1V)	SLOPE (H:1V)	icvee (rt.)	TION	TOE PROT- ECTION
99 INOP STRUCTURE (1022-98)	REACH 2 -	1677								· 		
200-200 21,24 13,7-15,2 2 1 6,100 ft. t. t	1056+00	1049492		E01-101-10-A	8	21,24	15.2	N		-	24" facing	6' facing
99 BROP STRUCTURE (1022-98) BD1-101-0-4	1049492	1032+20			300-320	21,24	13.7-15.2	- - •	8		8tone w/ 6,16" fltr i	stone + 3' derrick
24 IT-9-13-0	1032+20	1022+98			82	₹	13.0-13.7	- •	0,2	-		etone
December 1979 SDI-101-9-4	1022+98	1022+58	DROP STRUCTURE (1022+98)			7	17.9-13.01			0	24 facing stone w/	
No. LAURY IN N. (975-50) EDI-101-9-4 27 min 13.5-14.71 19.6-13.71 19.	1022+58	976+30		B01-101-10-A		24 min !	14.1-17.9!			·	lo" rilter	
S. P. R. R. (199-600) S. P. R. (199-600) S. P	976+30	970+00	LAKEVIEW AVE. (975+50)	E01-101-9-A		21 mtn	13.5-14.1	 ·				
13.5-18.5 13.	970400	09+696	INUE STRUCTURE (9/0+00)				18.5-13.51	 •		0		
Street Structure (907-00) EDI-101-9-A 16.4-19.4 16.4-19.4 1 1	09+696	907+00	RIVERSIDE FWY. (918+50) 1 TUSTIN AVE. (910+50)				13.5-18.51		0,2	-	stone w/ 1	
S.P.R.R. (890-00) EDI-101-9-4 16.4-19.4 14.7-16.4 1 14.7-16.7 1	907+00	806463	TROP STRUCTURE (907+00)				19.4-13.5!		2	0		
14.7-16.4 19.0-00) 14.7-16.4 19.7-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.7 19.8-14.8 19.8-14.7 19.8-14.8 19.8-	69+906	905+00		1 101-101 I			16.4-19.4			-		
99 DROP STRUCTURE (884-00) ED1-101-9-A	902+00						14.7-16.41	 •				
893+99 IROP STRUCTURE (884+00) E01-101-5-44	REACH 2 -	LONGER		5				·		-	24" fcg stn	
899-00 841+71 GLASSEL ST. (898+00) 801-101-5-AB 814-77 GLASSEL ST. (898+00) 801-101-5-AB 820-45 CARBON CIR. DIV. CH. (841+00) 801-101-5-AB 836-403 IRROP STRUCTURE (836+50) 801-101-5-A 803-403 IRROP STRUCTURE (836+50) 801-101-5-A 803-403 IRROP STRUCTURE (836+50) 801-101-5-A 803-403 IRROP STRUCTURE (830+50) 801-101-5-A 801-101-5	884+00	883+59	DROP STRUCTURE (884+00)	#-K-101-103	***		18.7-14.71				TITE TO (A.	
824-52 CARRENT CTUR. (841-60) 803-55 CARRENT CTUR. (841-60) 803-55 CARRENT CTUR. (841-60) 803-55 LINCOLM AVE (813-50) 803-63 LINCOLM AVE (742-60) 803-64-63 LINCOLM AVE (701-60) 803-64-63 LINCOLM RESIDENCY REPORTS AVERAGE AVERAG	883+59	859+00		יייייייייייייייייייייייייייייייייייייי		21 mtn	16.7-18.71		~	-	w/ 6" fitr	
836+50 CARBON CTN. DIV. CH. (841+00) E01-101-6-A	859+00	841+71		B01-101-5-AE 1		% adn	15.3-17	 ·	0,2	-		
803+69 DROP STRUCTURE (836+50) BD1-101-5-A 23.9-14.9 1 - 5 18" facing BD3+50 LINCOLM AVE (813+50) BD1-101-5-A 23.8-14.9 14.9-23.9 1 - 5 18" facing BD3+69 LINCOLM AVE (813+50) BD1-101-5-A 20 min 15.1-25 1 min 15.1-25 1 min 15.1-25 1 min 15.3-24 0 0 0 0 0 0 0 0 0	841+71	836450 0		201-101-6-A			14.9-15.31	 '		-		
803+50 LINCOLM AVE (813+50) 14.9-23.9 14.9-23.9 1 - 5 18" facing 803+50 IROP STRUCTURE (803+50) 23.8-14.9 0 stone v/ of filter 737+50 BOI-101-6-A 21 min 15.1-25 1 min 15.1-25 1 min 0 0 0 0 0 0 0 0 0	836+50	836+03	DROP STRUCTURE (836+50)	E01-101-5-A			23.9-14.9			0		
803+03 IROP STRUCTURE (803+50) 737+50 BALLA RD. (742+00) 737+50 BALLA RD. (742+00) 737+03 IROP STRUCTURE (737+50) 703+14 S.P.A.R. (725+50) 801-101-6-A 320 21 min 15.3-24 701+24 701+24 701+24 701+24 701+25 701+25 701+26 701+27 701+27 701+27 701+27 701+27 701+27 701+27 701+27 701+27 701+27 701+27 701+27 701+27 701-10-10-10-10-10-10-10-10-10-10-10-10-1	836+03	803+50	LINCOLN AVE (813+50)				14.9-23.9!			1-5-1		
737+50 BALL RD. (742+00) 737+50 BALL RD. (742+00) 737+03 DROP STRUCTURE (737+50) 801-101-6-A	803+50	803+03	DROP STRUCTURE (803+50)				23.8-14.91	•		0	stone v/	
737+03 DROP STRUCTURE (737+50) BD1-101-6-A 21 min 15.3-24 0,2 1-70 1	803+03	737+50	BALL RD. (742+00)			20 edn	15.1-25			nta t	o Illier	
703+14 S.P.R.R. (725+50) ED1-101-5-A 320 21 min 15.3-24 0,2 1-10 702+14 701+94 ED1-101-3-A 240-250 26 15 15-2 8 1.5-2 8 metaff. 701+94 701+20 250 26 15 1.5-2 8 metaff.	737+50	737+03	DROP STRUCTURE (737+50)	E01-101-6-A		21 atn	24-15.1			0		61 Pantara
702+14 701+20 70	737+03	703+14	S.P.R.R. (725+50)	E01-101-5-A		21 mdn 12	15.3-24		0,2	1 - 1		stone +
701+94	703+14	702+14		E01-101-6-A	350	21 utn 1	16.7-15.31	N	~	-		stone
701+20	702+14	701+94		E01-101-3-A	240-250	%	15	1.5 - 2			8" reinf.	9' reinf.
698492 KATELLA AVE. (701400) 1 250 1 250 1 26 1 16 1 1 1	701+94	701+20			250	%	15	1.5			concrete	3 derrick
	701+20	698492			520	%	9				-	a con

TABLE 1 (cont.)

					*****	EXTSTING	CHANNEL	COMPLITIONS	***** S		
REACH	74		ORANGE	CHANNEL	LEVEE	LEVEE	INSIDE	OUTSIDE	HEIGHT OF UNPRIECTED TOP OF	SLOPE	TYPE AND DEPTH OF
STATION FROM	<u></u>	LANDHARK (STATION)	DRAWING	NIDIH (ft.)	WIDTH (ft.)	HEIGHT (ft.)	SLOPE (H:1V)	SLOPE (H:1V)	(rt.)	TION	BCTTON
REACH 3											
698+92	697+83			952	*	13-16	1.5	- -	•		concrete +
697.483	90+69		E01-101-3-A	952	8	5	2 - 1.5 1	~		concrete	stone i
90+/69	00+289	CHANNEL (693+48) A.T.& S.P.R.R. (685+50)	E01-101-22	250-260	20 mtn	12-13.4	~	0	0		
00+289	87+189	DROP STRUCTURE (682+00)	B01-101-22	98	20 mtn 02	20.5-12		ou 1	0		
681+48	00+6/9	- 	E01-101-3-A	98	20 mtn 02	15-20.5			0		
00+649	664+75	CRANCE PAT. (675+00)		 %	15 adm	13					
664+75	662+75	• •		260-270	15 atn 1	£.			·		•
662+75	659+50	GRANCEMOND AVE. (661+00)		22	15 mdn [13			-		6' facing
05+659	657+50		E01-101-3-4	270-260	15 min 1	13		0		18" facing	3' derrick
00+729	00+959		E01-101-22	210	있 양	12.5-12		2	0	stone w/	stone
00+959	637+50			210-240	20 mtn.	12.5	~		0	182	
637+50	637+00			240-260	20 etn	12.5	3-2		0		
637+00	636+43	DROP SRUCTURE (637+00)		98	20 ata	20-12.5	~		0		
636463	628+95	CHAPMAN AVE. (630+80)	101-101-22	260-210	20 atn	15.2-20	~ • •	'n	1-0		
628495	622+06		D01-101-3-A	980	15 min 1	13		0	-		
622+06	617+50	BITTERBUSH CANAL (621+00) SANTA ANA FWY. (617+50)	801-701-2A		% dia 0.2	21	~	~	4		4. Iacing
617+50	593+35	S.P.R.R. (616+50)	B01-101-22		20 min. 1	12.5	2,3	0	0		6' facing
\$63+35	592+84	DROP STRUCTURE (593+35)		•	20 sth	19.6-12.51	~	0	0		3' derrick
992+84	590463		101-101-22		20 utn (15.6-19.61	'n	0	o	-	
690463	557+25	GARDEN GROVE BLVD. (575+00) STABILIZER (574+00)			8	2	m	~~~	2	лоре	none
REACH 4		SANITARA UN. CAREL. (230730)	E01-701-2-A								
557+25	551+00	-			8	12.5-13	m	~	2 - 4.	18" rock	7, rock
		- -				* ***	v. elde: 1	v side:	e. etde: 1	v. side:	v. side:
551+00	526+00		E08-701-1	92	&	13-12.5	e. side:	e side:	7-2	e. side: 18" rock 1	e. side
٠,	MACCA	-	- C	250-220	6	13.4	~	0	3.70	7-8" reinf.	8' R

TABLE 1 (cont.)

					*****	EXISTING	CHANNEZ.	CONDITIONS	***** S		
REACH	중		ORANGE	CHANNEL	LEVEE	Gentles i	INSIDE	OUTSIDE	HEIGHT OF UNPRIECTO	SLOPE	TYPE AND DEPTH OF
STATION	, <u>2</u>	LANDMARK (STATION)	DRAWING I NUMBER	WIDTH (ft.)	Cr.)	(ft.)	SLOPE SLOPE (H:1V)		LEVEE (ft.)	TION	TOE PROT- ECTION
REACH 5 - UPPER	UPPER										
909400	609-00 425-00	PAIRVIEW ST. (501+00) STABILIZER (4,98+00) S.P.R.R. (4,81+00) STABILIZER (4,74+00) FIFTH ST. (4,66+00) BOISA AVE. (4,52+00) STABILIZER (4,45+50)	E01-101-18	87	유 원	13.4	(cr. cr. cr. cr. cr	l a	3.7		8' reinforced concrete
772	398+00	MCPADDEN AVE. (421+50)	1 BO1-101-18 & 1	83		13.4					
398+00	393+00	STABILIZER (419+00)	1 BO1-101-13-A 1	220-180		14.5-13.4				- - 8-7	
393+00	356+64	EDINCER AVE. (385+00)		8		14.5				reinf. conc.l	concrete
356464	354+60	STABILIZER (382+50)		85		15-14-5			3.7	 ·	
354.460	261+00	HARBOR BLVD. (342+00) MARNER AVE (334+00) STABILIZER (229+30) SLATER AVE (311+00) TALBERT AVE (282+00) STABILIZER (275+00)		8		÷	~		0 - 3.7	- 4 - 	6-8' reinforced concrete
REACH 5 - LONGR	LONGER							- ~ -			
261+00	260+00		1 DO1-101-13-4	180-190		17-15	1.5 - 2		3.7-1		
360+00	235+00	SAN DIEGO FWY. (254+32)	E01-101-15-A	8		12	1.5			reinforced	1,7
235+00	219+00			8						929-12000	+ 7! + 7!
219+00	215+00		E01-101-15-A	8.	20 min.						
215+00	214+00		B01-101-19-A	190-230	8				0	- -	
214+00	170+54		E01-101-19-A	230	8					- 	.
170+54	158+10	ADAMS AVE. (163+71)	F01-701-7	230	ୡ			~			
158+10	153+00		E01-101-19-A	530	20,25			1.75,21		**	4,1
153+00	133+71	PAIRVIEM CHANNEL (143+00)	E01-101-19-A	230	20,25	12	1.5	1.75,21	0	reinforced	rip-rup

TABLE 1 (cont.)

	ĺ		-		****	EXISTING	CHANNEL.	CONDITIONS	****** SN		
REACH STATION FROM	, <u>2</u> # 5	LANDMARK (STATION)	ORANGE COUNTY DRAWING NUMBER	CHANNEL BASE WIDTH (ft.)	LEVEE BERN WIDTH (ft.)	LEVEE HEIGHT (ft.)	INSIDE SIDE SLOPE (H: 1V)	OUTSIDE SIDE SLOPE (H:1V)	HEIGHT OF UNIFFIECTO TOP OF LEVEE (FL.)	SLOPE PROTEC- TION	TTPE AND DEPTH OP TOE PROT- BCTION
REACH 6											concrete
133+71	132+71		1 E01-101-21	230	20,25	18-17	2.5	1.75,21	0	6" 6	rip-rap
132+71	07+16			230		18	 :			concrete	
07+16	07+88		·	230-220			- - •				
REACH 7					- - ·					 •	-7
07+88	00+67	HAMILTON AVE. (82+16)		8	20,25		 •			 -	+ 3+
43+00	71+00			220-195	20-45						du-dia
41+00	30+00			195	15-57	~ ·	· •				
30+00	23+18		- - ,	195	%	18	1.5				concreted
23+18	20+00		1 301-101-21	195-160	25-20	16-18	2 - 1.5	1.75,21	·· •• ·	concrete	stone
20+00	14+50		E01-701-1-A	160-180	~ - .	18-16	0-2	~		8-18" R.C.	
14+50	\$35	PACIFIC COAST HWY. (9+47)		180-176	20-25	16-18	0	1,2	** *** *	10-18" R.C.	concrete
9+35	7+00			176-204	12-0-51	91	2 - 0	1.5,1		8-18" R.C. 1	TUANT
7+00	00+00	_	B01-701-1-4 I	204-316	120	16 1	2,1.5	1.75,11	0	7-6' rock	6-7.5' stn

Table 2. Lower Santa Ana River. Major Significant Faults

Fault	Fault Length (mi)	Min. Dist. to Site (mi)	Epice Magni MCE ^a		Max. I Accel. MCE	
San Andreas	630	32	8.5.	8.25	0.25	0.25
Newport- Inglewood	35+	0 ,	7.0	6.0	0.70	0.60
Whittier- Elsinore	145	1	7.5	6.5	0.73	0.65
San Jacinto	145	27	7.5	7.2	0.20	0.18
Sierra Madre	60+	18	7.0	6.0	0.25	0.15
Palos Verdes	40	11	7.0	5.5	0.35	0.15

<sup>a. MCE: Maximum Credible Earthquake, from Leeds (1979).
b. MPE: Maximum Probable Earthquake, from Leeds (1979).
c. Data in columns from Schnabel and Seed (1973) and Greensfelder</sup> (1974).

Table 3. Lower Santa Ana River.

Significant Earthquakes (Richter Magnitude 6+) Since 1900^a

Date	Probable Causative Fault	Richter Magnitude	Min. Dist. to site (mi)
9/20/1907	San Andreas (?)	6.0	42
5/15/1910	Elsinore (?)	6.0	21
10/23/1916	?	6.0	96
4/21/1918	San Jacinto	6.8	41
7/23/1923	San Jacinto	6.3	33
3/11/1933	Newport-Inglewood	6.3	1
3/25/1937	San Jacinto	6.0	90
12/4/1948	Mission Creek	6.5	77
2/9/1971	San Fernando (Sierra Madre)	6.4	51

a. From Yerkes (1985) and Real and others (1978).

Table 4. Lower Santa Ana River.

Channel Foundation Investigation Reports

			Location	Station
Title	Prepared By	Date	Symbol	reach
Geotechnical Evaluation of Proposed Improvements of Santa Ana River Channel	Woodward-Clyde Consultants	1/6/78	WC78	20-133
Geotechnical Investi- gation Santa Ana River Channel Improvements	Woodward-Clyde Consultants	1/17/77	WC77	50-190
Dike Stability Investi- gation Santa Ana River	Woodward-McNeill & Associates	6/15/73	WM73	220-470
Soils Investigation, Santa Ana Interceptor Sewer	Geolabs- California, Inc.	7/27/71	GC71	225 - 702
Soil Investigation, Santa Ana River Drop Structures	Moore & Taber	5/31/78	MT78	558-701
Santa Ana River Study	Moore & Taber	3/19/64	MT64	605-1053
Foundation Investigation, Santa Ana River Structures	Moore & Taber	4/3/68	MT68	638-686
Foundation Investigation, Santa Ana River Levee	W.A. Wahler & Associates	7/24/69	WA69	708-854
Buttress Stabilization of Burris Sand Pit	Foundation Engineering Co., Inc.	4/15/75	FE7 5	730-820
Stability Investigation, Santa Ana River Levee	Moore & Taber	5/13/66	MT66	737-796
Preliminary Site Evalu- ation, Santa Ana R ⁴ er Spreading Basin Development	Woodward-McNeill & Associates	8/2/74	WM74	768-975
Soil Investigation, Santa Ana River Channel	Moore & Taber	10/29/70	MT70	846-1057
Soil Investigation, Santa Ana River Interceptor Sewer	Southern California Testing Laborato	5/12/75 ry	SCT75	910-1058

Table 4. (Continued)

Title	Prepared By	Date	Location Symbol	Station Reach
Soil Investigation, Santa Ana River Interceptor Sewer	Southern California Testing Laboratory	9/10/75	SC75	1112-1216
Geotechnical Investi- gation Santa Ana River Drop Structure Weir Canyon Road	Moore & Taber	3/12/80	MT80	1171-1196
Foundation Investi- gation & Analysis, Santa Ana River	Geolabs- California, Inc.	5/24/72	GC72	1171-1215

Table 5. Lower Santa Ana River.

Bridge Foundation Investigation Reports

Title	Prepared By	Date	Location Symbol	Station
Foundation Investigation, Hamilton-Victoria Bridge Across Santa Ana River	Orange County	3/31/76	0076	82
Foundation Investigation, Adams Ave. Bridge Across Santa Ana River	Orange County	6/5/68	0C68	164
Foundation Investigation, Slater-Segestrom Bridge Across Santa Ana River	Orange County	12/9/71	0071	311
Foundation Investigation McFadden Ave. Bridge Across Santa Ana River	Orange County	12/15/75	0075	421
Foundation Investigation, Seventeenth Street Bridge Across Santa Ana River	Orange County	8/20/75	0075	513
Soils Logs for Garden Grove Blvd. Bridge Across Santa Ana River	Orange County	10/71	0071	575
Foundation Investigation Weir Canyon Rd. Bridge Across Santa Ana River	Moore & Taber	8/26/82	MT82	1202

TABLE 6

LOWER SANTA ANA RIVER SUMMARY OF EXPLORATIONS

STATION	LOG NUMBER	DEPTH (ft.)	EQUIPMNT	DATE	WATER DEPTH I (ft.)	LOG	SAMPLES
REACH I							
1207+00R	0801	25.0	B.A.	10-31-84		8	F
1171+50R		27.0	B.A.	10-26-84		8	L,F
1171+00L	0806	30.0	B.A.	11-19-84		8	L,F
1171+00C	0871	15.0		11-19-84	5.0	8	I
1148+00R	0901	40.5		11-19-84	18.0	9	L,F
1148+00L		40.0		11-16-84		9	L,F
1130+50R	0903	30.0	B.A.	10-29-84	15.0	9	L,F
1129+00L	0904	26.0		11-14-84		9	L,F
1115+00R		25.0		11-20-84	18.0	9	L,F
1097+00R		40.0		10-31-84	16.5	9	L,F
1097+00L		40.0		11-14-84		9	L,F
1080+00R		30.0		11-01-84		10	L,F
1080+00L		30.5		11-13-84		10	L,F
1080+00C		11.5		11-19-84	4.5	10	I
1062+00C		13.0		11-20-84		10	I
1063+40R		30.0		10-29-84	16.0	10	L,F
1062+00L	1004	30.0	B.A.	11-13-84		10	L,F
REACH II							
UPPER							
1046+00C		15.0		11-20-84		10	I
1064+00R		30.0		11-12-84	17.5	10	L,F
1046+00L		30.0		11-12-84		10	L,F
1023+00R		40.0		10-30-84	21.0	11	L,F
1023+00L		39.0		11-12-84		11	L,F
1007+00C		8.6		11-15-84		11	Ţ
1007+00R		35.0		11-02-84		11	L,F
1007+00L		35.0		11-09-84		11	L,F
985+00C		7.0		11-15-84		11	Ī
985+00R		35.0		11-15-84	18.0	11	L,F
985+00L		35.0		11-07-84		11	L,F
970+00L		39.0		11-09-84		11	L,F
960+00R		30.0		11-20-84		12	L,F
950+00R		35.0		11-05-84		12	L,F
950+00L 940+00L		35.0		11-08-84	22.0	12	L,F
	1204	27.0		11-08-84		12	
		34.0		11-07-84	22.5	12	
	1207				16.5		
910+00L 900+00R					17.4		
895+00L							
885+00E		35.0	B.A.	11-00-04	16.5 20.0	13	
005+00K	1303	35.0	D.A.	11-00-04	20.0	7.3	ם, ב
BA=BUCKI	ET AUGER		BH=BACKI	HOE	FA=FLIGHT	AUGE	R

BA=BUCKET AUGER BH=BACKHOE FA=FLIGHT AUGE L=LEVEE F=FOUNDATION I=INVERT

TABLE 6 (Cont.)

LOWER SANTA ANA RIVER SUMMARY OF EXPLORATIONS

STATION	LOG NUMBER	DEPTH E	QUIPMNT	DATE	WATER DEPTH (ft.)	LOG PLATE	SAMPLES
REACH II			<u> </u>		-		
LOWER							
875+00I		38.5	B.A.	11-09-83	19.5	13	L,F
875+000		21.0	B.A.	12-12-84	18.0	13	_ <u>I</u>
875+001		45.0	B.A.	11-16-83	17.0	13	L,F
865+001		35.0	B.A.	11-17-83	17.0	13	L,F
854+000		17.0	B.H.	11-23-84		13	_ I
854+001		24.0	B.A.	11-10-83	21.0	13	L,F
854+001		40.0	B.A.	11-17-83	21.0	13	L,F
840+001		35.0	B.A.	11-23-83		14	L,F
830+001		36.0	B.A.	12-19-84		14	L,F
820+001		40.0	B.A.	11-23-83		14	L,F
820+001		34.0	B.A.	11-19-83		14	L,F
810+001		31.0	B.A.	11-25-83		14	L,F
800+001		40.0	B.A.	11-21-83		14	L,F
789+000		15.0	в.н.	11-23-84		14	_ I
789+001		43.0	B.A.	11-28-83		14	L,F
789+00		40.0	B.A.	11-22-83	29.0	14	L,F
780+00		34.5	B.A.	11-30-84		15	L,F
771+00		40.0	B.A.	11-28-83	20.0	15	L,F
771+00		40.0	B.A.	11-29-84		15	L,F
760+001		35.0	B.A.	11-30-84		15	L,F
753+00		15.0	в.н.	11-27-84	3.5	15	I
753+00		40.0	B.A.	12-04-84		15	L,F
753+00		40.0	B.A.	11-06-84		15	L,F
740+00		30.0	B.A.	11-27-84		15	L,F
730+00		36.0	B.A.	11-27-84		15	L,F
719+00		12.5	B.H.	11-27-84		15	_ I
719+00		40.0	B.A.	11-05-84		15	
719+00		40.0	B.A.	11-26-84		15	
710+00	L 1601	25.0	B.A.	12-04-84		16	L,F

BA=BUCKET AUGER BH=BACKHOE FA=FLIGHT AUGER
L=LEVEE F=FOUNDATION I=INVERT

TABLE 6 (Cont.)

LOWER SANTA ANA RIVER SUMMARY OF EXPLORATIONS

STATION		DEPTH (ft.)	EQUIPMNT	DATE	WATER DEPTH (ft.)	LOG PLATE	SAMPLES
REACH III							
699+00C	1671	15.0	B.H.	11-29-84		16	I
699+00R	1602	18.0	B.A.	08-17-83		16	Ĺ
699+00L	1603	25.5	B.A.	08-17-83		16	L,F
690+00L		26.0	B.A.	08-16-83	18.0	16	L,F
680+00L		36.0	B.A.	08-12-83		16	L,F
665+00L		30.0		08-11-83	14.0	16	L,F
657+00R		36.0		12-11-84		16	L,F
657+00L		30.0		08-10-83		16	L,F
657+00C		15.0		11-26-84	1.0	16	I
644+00L		30.0		08-10-83		17	L,F
636+00L		40.0	B.A.	08-08-83	21.0	17	L,F
622+00L		31.0	B.A.	08-08-83	19.0	17	L,F
615+50R		30.0		08-11-83	29.5	17	L,F
615+00C		15.0		11-29-84		17	I
614+00L		30.0	B.A.	08-05-83		17	L,F
601+50L		27.0		08-04-83	24.0	17	L,F
590+00L		35.0	B.A.	08-04-83	12.0	17	L,F
574+00L		23.0	B.A.	08-03-83		18	F
572+00R		31.5	B.A.	08-01-83	27.0	18	L,F
561+00R	1803	30.0	B.A.	08-01-83.		18	L,F
561+00L	1804	20.0	B.A.	08-02-83	16.0	18	L,F
559+00L		S 30.0	B.A.	10-01-79	27.5	18	F
553+00R		30.0	B.A.	07-29-83	24.0	18	L,F
548+50L	1805	27.5	B.A.	08-02-83	20.0	18	F
540+00R	1806	30.0	B.A.	07-28-83	26.0	18	L,F
535+00L	1811	26.0	B.A.	08-02-83		18	F
531+00R	1808	30.0	B.A.	07-28-83		18	L,F

BA=BUCKET AUGER

BH=BACKHOE

FA=FLIGHT AUGER

L=LEVEE

F=FOUNDATION

I=INVERT

TABLE 6 (Cont.)

LOWER SANTA ANA RIVER SUMMARY OF EXPLORATIONS

STATION	LOG NUMBER	DEPTH (ft.)	EQUIPMNT	DATE	WATER DEPTH (ft.)	LOG PLATE	SAMPLES
REACH IV		*					
524+50E		30.0	B.A.	07-28-83		18	L,F
522+501	1810	29.0	B.A.	07-27-83		18	L,F
518+000	TT79-22	10.0	B.H.	07-13-79		19	Ï
518+000	1981	5.0	B.H.	11-26-84		19	I
REACH V						19	
UPPER						19	
508+801		30.0		07-26-83	17.5	19	L,F
	C TT79-21			07-13-79		19	Ī
495+001		31.0		07-26-83	17.0	19	L,F
485+001		29.0		07-22-83	23.0	19	L,F
	TT79-20		B.H.	07-13-79		19	Ι
477+000		10.0		12-04-84		19	ī
474+001		31.5		07-22-83	28.5	19	L,F
474+00F		30.0		12-14-84		19	L,F
468+001		31.5		07-20-83	24.0	19	L,F
460+001		31.5		07-19-83		19	L,F
458+000				07-12-79		19	I, I
449+001		31.5		07-18-83		20	L,F
440+001		31.5		07-18-83	22.0	20	L,F
	TT79-18			07-12-79		20	Z,I
437+500		10.0		12-04-84		20	Ī
430+001		29.0		07-07-83		20	L,F
420+00R		31.5		07-19-83		20	L,F
419+001		28.0		07-07-83		20	L,F
	TT79-17			07-12-79		20	-/I
410+001		28.0		07-06-83		20	L, F
400+00L		30.0		07-01-83		20	L,F
	TT79-16			07-11-79		20	Į, į
395+000		4.0	B.H.	12-14-84		20	ī
390+00L		34.0	B.A.	06-30-83		20	L, F
380+00L		31.0	B.A.	06-24-83		21	L,F
	TT79-15		B.H.	07-11-79		21	I, F
370+00R		26.5	B.A.	06-23-83		21	L,F
370+00L		31.0	B.A.	06-27-83		21	L,F
360+00L		31.0		06-28-83		21	L,F
358+00C	TT79-14	2.0		07-10-79		21	I, I

BA=BUCKET AUGER	BH=BACKHOE	FA=FLIGHT AUGER
L=LEVEE	F=FOUNDATION	I=INVERT

TABLE 6 (Cont.)

LOWER SANTA ANA RIVER SUMMARY OF EXPLORATIONS

STATION	LOG NUMBER	DEPTH (ft.)	EQUIPMNT	DATE	WATER DEPTH I (ft.)	LOG PLATE	SAMPLES
REACH V							
LOWER				06 00 00			
350+001		31.0		06-29-83		21	L,F
338+001		31.0		06-29-83		21	L,F
	TT79-1			07-10-79		21	I
330+001		30.0		12-13-83		21	L,F
320+001		30.0		12-22-83		22	L,F
320+001		30.0		12-17-84		22	L,F
	TT79-1:			07-10-79		22	_ I
310+001		30.0		12-14-84		22	L,F
300+001		31.5		06-20-83		22	L,F
299+000	C TT79-1			07-10-79		22	I
290+001	L 2205	30.0		06-16-83	20.0	22	L,F
280+001	L 2206	30.0	B.A.	06-15-83	21.0	22	L,F
276+000	TT79-1	0 4.0	B.H.	07-10-79		22	I
276+000	2282	3.0	B.H.	12-11-84		22	I
270+001		28.5	B.A.	06-22-83		22	L,F
270+001		30.0	B.A.	06-15-83	20.0	22	L,F
260+001		31.0		06-14-83		22	L,F
	TT79-9			07-10-79		23	Ī
246+001		30.0		03-23-83	16.5	23	L,F
238+001		21.0		12-06-84		23	-,- F
	TT79-8			07-09-79		23	Ī
236+001		30.0		03-23-83	19.0	23	L,F
227+501		9.5		03-10-83	6.5	23	F
226+001		30.0		03-22-83	15.0	23	L,F
222+001		10.5		03-10-83	7.5	23	F
217+001		29.0		03-07-83		23	L,F
	TT79-7	10.0		07-09-79	23.0	23	I,r
216+001		30.0		03-22-83	14.0	23	
211+001		11.5			6.5	23	L,F F
				03-07-83			
206+001		30.0		03-22-83	19.0	23	L,F
200+001		27.0		02-28-83	24.0	23	L, F
199+000				07-09-79		23	_ I
196+001		30.0		03-18-83		23	L,F
190+001		29.0		02-28-83	23.0	24	L,F
	R 2432			03-16-83		24	L,F
	2403			03-07-83	5 .5		_
	L 2404			02-25-83		24	•
	C TT79-5			07-06-73		24	
	R 2435	30.0		03-16-83		24	
170+001				02-25-83	22.5	24	
157+001		21.0	B.A.	03-08-83		24	L,F
152+001	R 2438	30.0		03-16-83	19.5	24	
147+001	L 2409	23.5	B.A.	03-08-83	18.5		•
BA=BUC	KET AUGE	R	BH=BAC	КНОЕ	FA=FLIG	HT AUG	ER
L=LEVE	E		F=FOUN	DATION	I=INVER	T	

TABLE 6 (Cont.)

LOWER SANTA ANA RIVER SUMMARY OF EXPLORATIONS

STATION	LOG NUMBER	DEPTH (ft.)	EQUIPMNT	DATE	WATER DEPTH (ft.)	LOG PLATE	SAMPLES
REACH VI							
142+50F	2440	45.0	F.A.	03-23-83	19.0	24	L,F
	TT79-4	10.0		07-06-79		24	-,-
138+50F		45.0		03-25-83	16.5	24	L, F
130+001		45.0		03-31-83	25.0	25	L,F
125+001		35.0		03-31-83	13.0	25	F
120+00F		45.0		03-25-83	18.0	25	L,F
	TT79-3	10.0		07-06-79		25	Ī
	TT79-2	4.0				25	Ī
115+001		35.0				25	F
111+001		45.0		03-10-83	21.0	25	L,F
110+00F		45.0				25	L,F
105+001		44.0		03-30-83		25	L,F
100+00F		45.0	F.A.	03-28-83		25	L,F
98+000		10.0		12-11-84		25	I,
	TT79-1	10.0		07-05-79		25	ī
95+001		35.0		04-01-83	15.0	25	F
90+501		40.5			20.0	25	L,F
90+001		45.0		03-28-83		25	L,F
86+001		35.0		03-29-83		25 25	F.
	TH79-10			08-07-79		25	F
REACH VI		, ,,,,,		00 07 73	14.5	23	•
76+72F		50.0	F.A.	04-07-83	24.0	25	L,F
70+501		50.5		04-08-83		25	F
	R TH79-9	28.0		08-02-79		25 25	F
	TH79-8	39.0		08-02-79		25 25	F
60+00F		45.0		04-07-83		26	L,F
	TH79-7	39.0		08-06-79	_	26	F
54+251		45.0		04-12-83	11.0	26 26	L,F
50+000		10.0		12-13-84	11.0	26	I,I
48+00F		45.0		04-06-83	17.0	26	L,F
	TH79-6	39.0		08-07-79		26 26	F
	TH79-5	38.0		08-07-79		26 26	L, F
37+251		45.0		04-11-83		26	r F
30+00F		45.0		04-04-83	20.0	26	L,F
	TH79-4	39.0		08-06-79	18.5	26	E,F
	L TH79-3	39.0			10.6	26 26	F
	2635	45.0		04-04-83	15.0	26	
	R TH79-2	39.5		08-01-79		26	E, F
-	2636	45.0		04-11-83		26	
10+00F		45.0		04-11-83		26 26	
	TH79-1	39.0		08-01-79		26	F
0+001	J 111751	39.0	r.a.	08-01-79	12.0	20	•
BA=BU	CKET AUG	ER	BH=BA	CKHOE	FA=FI	IGHT AU	IGER
L=LEV	EE		F=FOU	NDATION	I=INV	ERT	

TABLE 7
LOWER SANTA RNA RIVER
SED SOLI TEST BESINT SIMMODY

••		 0;<	••	••	••		Hech.	ch. Analy. % finer:	 >	•• ••	Field	Densities Compac	sities Compaction max	••••	X Q X	₩.	Shear S U.U.	Strength U.D.		6. 0	<u>ي</u> د د	Con- : soli-:Permea	1100
Station	₹ ₹ •	Seriel Ko.	Report: Del : Date : From	<u>ች</u>		Cl ass	send	fine; LL \$200;	<u>.</u>		dry R PCF Mois	st: mth	dry PCF	Noist :	den. test	Samp	ا او	O C deg taf		O C deg tsf		atio:b	datio:bility: Cc :ft/day:
1207+00:	8	91509	: 12-65	0.9		₽.	9 8	24	23 :	 E				••				ŀ		ł	••	••	
1207+00:	2	91510	: 12-85		0	ರ	¥ 		:: =			Ę.		10.7		9-E					 e		••
1207+00:		91511	: 12-85		••	<u>.</u>	<u>ب</u>	16	= :	 <u>.</u> .		£		FT	8	<u>ب</u>		11	0.0	23 23	0.0		•••
1171+50:		: 91512	: 12-85	0.6	• •	<u>S</u>	 35	•	= :	 Z		€ :	118.0	12.5		¥-1					 e		••
1171+00:	90	: 91513	: 12-85	•	 	<u>F</u>	35	 82			i	€		12.2		<u>ا ا</u>							••
1146+00:		91043	: 12-85		0	ರ	 100 	92	7	••	88.4 32.3	 M				J-E							••
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950+00	1203	91554	: 12-85		••	55-25	••	••	••	 ≩				••							••	••	••
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0771+00	1503	9104	: 12-85			ರ	 81 82	••	<u></u>	19:11	117.3 10.8	 ~		••		<u></u>	3.25				• •	••	••
0771+00	2	91045	: 12-85		••	ರ	 8	••	31:1	<u>.</u>				••									
0760+00:	150	91526	: 12-85		29.0	돐	66 	21	.	ē- ∵				••									
0753+00:	1506	: 91527	: 1-96			£	£ 	••		<u>⊶</u>		Şt.		12.0								~	2.1-15
0753+00;	:	91528	: 12-95			ರ	901 ::		•-	11 :		₽.	114.8	11.5	8	æ-E		ī	 6.9	33 0	0.0		
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0719+00;	1510	91046	12-85		•••	7	••	23									1				•••	••	•••
0719+00:	:	91047	: 12-85		••	<u>ئ</u>	9	••			114.4 16.6	•••	•			_ 	0.75					•••	•••
0719+00:	503	91530	: 12-82		•-	£		25	-	 ≩		2	119.4	£.6	9	-K		22	8.1	9	 0.0		
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0699+00:	2097	91532	1-86		• •	h i	F :	יי ני	- 2		è		107.1	5.01		=					٠.	Ÿ.	.007-0
0657400	16U	BF016 .	C9-21	0.05	• •	f a	3 5	200	• •		25. E. S.			••		ם-ר		ר כ	2	g			• •
0627460	101	61016	12-05		••	d 5	3 5	• •	2		ò					=	1.05				• •	• •	• ••
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047400:	1905	91533	: 12-85		••	ಚ	100	79	30 30												••	••	••
0310+00:	2203	: 91534	: 1-86	:27.0 30	30.0	뒫	100	••	52	 რ		st.	111.5	13.5							••	<u>:</u>	. 1 5-
0236+00:	2301	82536	: 9-83		••	SP-SH	••	12	:				102.5	15.5		;						••	•••
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0236+00;	:	91024	: 12-85	: 15.0	••	ರ	001	2	5:2	•-) ⊒_	0.45				:	 ;	•••
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0217+00	2307	82538	9-63		• • •	<u>.</u>	5 (22.0				, ,	115.6	2.5	3 8	¥ 4		00) (
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	:	LLC78 :	69-63		•	5	001	r	•			. 36									•	•	•

1.

TABLE 7 (continued) LOWER SANTA RANA RIVER SPD SOIL TEST RESULT SUMMARY

Seport Depth Class sand fine L PI Pi								: Mech. Analy.	Ana	ly.	••		Densi ties	ties		×		Shear		Strongth		••	Con	••
No. Control	••		: Div.	••		••			finer		••	P1d		mpactic	XOR C	I OX		u.u.	=	<u>.</u>		••	soli-	Perm
2401 62546 9483 0.0 3.0 151 2 54,118-5 10.7 3.0 <th< th=""><th>Station</th><th></th><th>Serial No.</th><th>Report</th><th>From P</th><th>••••</th><th>C1 4 51</th><th></th><th>fine \$200</th><th></th><th><u> </u></th><th></th><th>ist: ut</th><th></th><th>Moi st</th><th>••••</th><th></th><th></th><th></th><th>ts c</th><th></th><th> </th><th>i C</th><th>£ 5</th></th<>	Station		Serial No.	Report	From P	••••	C1 4 51		fine \$200		<u> </u>		ist: ut		Moi st	••••				ts c		 	i C	£ 5
2407 82547 9-88 6-8 1-1 541 100 33 20 2 51 110.0 111.0 10 2 10 2 111.0 11.0 11.0 2 11.0 11.0 2 11.0 2 11.0 11.0 2 11.0 11.0 2 11.0 11.0 2 11.0 11.0 2 11.0 11.0 2 11.0 11.0 2 11.0 2 2 11.0 2	0190+00:	201	82545	. 9-63	1		15	- 8	30	.21	2	t 1 1 1 1 1	: 54	119.5	i ''		} ! !	[-	! ! !					<u> </u>
2405 6254 9-69 3.6 11 3.5 11.6 11.5 11.	0190+001	:	82546	: 9-83		••	돐	100	33	202	 N		:St	. 116.6	•		3-R		£	1.0		. 0.0		
2407 62540 540 45 52 7 53 1115 31 31 31 31 31 32 7 1115 31 31 31 32	0177+50:	2403	82547	: 9-83	•	••	₹ 5	901	23	••	<u>₹</u>		: 5		-							••		••
86250 9-80 17 18 1 55. 114.7 13.3 90 3-R 17. 18 1 55. 114.7 13.3 90 3-R 17. 18 1 55. 114.7 13.3 90 3-R 13.5 1	0157+00;	2	82548	: 8-63		••	5-25	÷	f	ĸ	<u>~</u>		:5		-	••						••		
2408 62525 9-63 75. 111.5 13.3 9 9 9 9 9 9 9 9 9 9 9 9 9 11.1.5 13.3 9 9 12.0	0157+00:	:	82549	: 9-83		••	₹ 5		17	•-	 -		:5				₩. ₩.		27	1.2	35	. 0.0		••
2408 62525 9-89 4.5 5.0 100 - 50 6.0 100 - 50	0157+00;	3	82550	: 9-83	••	••	51-15	÷	ው		ď		3		• •	••						••		
2902 82625 9-83 20.0 21.0 CL 1100 72 14 91.0 S	0157+00:	2408 13408	82551	: 9-83		••	돐	8 6	88		٠. چ		:5									••		
2002 62625 9-63	0147+00;	5	82552	: 8-63		••	ರ	100	22		50		:5	. 108.0		••						••		
2536 62862 9-63 III. 100 99 75 42 25.3 9 7 95.2 7 95.2 7 95.2 7 95.2 7 95.2 95.2 7 95.2	0130+00:	2501	82825	: 9-63		<u></u>	3	9	86	••	₽	81.4 39	9.			••						••		
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233 62828 9-83 157 100 99 75.0 100 99 75.1 97.1 97.5 98 98 99 77.7 91 97.2 98.3 99.3 11.5	0125+00:	2202	82827	: 9-63		<u></u>	步	901	86	8:	₹		6			••						••		•-
2333 62862 9-83 11.5 16.5 CH 100 99 73 40 80.7 37.1 80.7 40.1 " 82831 9-83 11.5 21.5 CH 100 19 73 72.6.7 90.7 40.1 " 82831 9-83 24.5 27.5 SH 100 11 HP 93.7 26.7 90.7 11 HP 93.7 26.7 " 82832 9-83 24.5 27.5 SH 100 11 HP 103.1 14.8 5t. 108.1 0.3 9-R " 91057 12-85 12.0 CH 100 93 34 7.1 100 95 34 95 34 95 34 95 34 95 95 34 95 95 34 95 95 34 96 97 </th <th>0125+00:</th> <th>3</th> <td>82828</td> <td>: 8-83</td> <td></td> <td></td> <td>돐</td> <td>500</td> <td>53</td> <td>••</td> <td>웊</td> <td></td> <td> m</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>••</td> <td></td> <td>••</td>	0125+00:	3	82828	: 8-83			돐	500	53	••	웊		 m									••		••
10	0120+00:	2533	82829	: 9-83		••	3	100	66	£.	9											••		
10.00 1.00	0120+00:	3	82830	: 9-63			ᇙ	. 100	100	: 16:	54											••		
17-79-2 17-7	0120+00:	2	82831	: 69-6:		••	£	100	83	-	<u></u>	_	35 :			••						••		
1.533 9-83 29-0 31.5 SP-SH 100 11 11 11 11 11 11	0120+00:	:	82832	: 8-6:			돐		7		 ₽					••						••		
19 19 19 19 19 19 19 19	0120+00:	=	82833	: 8-63		••	SP-SF		11	••	 ₽		 8.			•-						••		••
2534 91056 12-85 12.0 CH 100 99 33 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 2 91.31 3 3 3 3 4 3 3 4 3 3 4 3 4 3 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4	0117+00:1	7-62-	71825	: 1-90		••	SP-SF		~		 ≩		••	108.			₩ ₩							••
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1905 12-65	0115+00;	:	91057	: 12-85 :	15.0	Ξ.	룯	 200 100	8	: 33	~						ا ا					••		••
T-79-11 71824 1-80 7.0 10.0 5.1 100 96 44 19 19 19 19 19 19 19	0115+00:	:		: 12-85 :		••	<u>5</u>	 8	묽		<u>₹</u>		••									••		
79-10 71832 1-80 16.0 - 14. 100 55 1 MP 92.9 30.4 2-0 2-0 2-0 2-0 2-0 0.14 2546 91062 12-65 1.2 51 100 67 13 22. 10.1 0.65 9.0 0.01 79-8 71822 12-65 12.0 51 100 77 35 13 54. 10.5 14.5 94 3-7 95 3.2. 95 3-8 0.0 0.013 79-8 71822 1-80 15.0 - 14. 100 41. 23 2 54. 10.5 14.5 94. 95. 95. 3-8 95.	0098+00:1	1-6-		: 1-80		••	ಕ	 2	୫	*	13						ų, Š					••		
2546 91062 12-65 4.5 CL 100 67 49 224 64.3 32.7 1-0 0.65 79-6 91063 12-65 12.0 5H 100 74 23 2 54. 103.3 19.5 95 3-R 35% 0.0 0.0 113 95.9 2-H 54. 100.5 14.5 94 3-R 35% 0.0 0.0 13 95.9 14.5 94 3-R 35% 0.0 0.0 13 10.0 <t< th=""><th>0082+003</th><th>29-10</th><th></th><th>: 1-80</th><th>16.0</th><th>••</th><th>룯</th><th> 19</th><th>55</th><th></th><th> 2</th><th></th><th> T.</th><th></th><th></th><th></th><th>7</th><th></th><th></th><th>1.2</th><th></th><th>•••</th><th>0.14</th><th></th></t<>	0082+003	29-10		: 1-80	16.0	••	룯	 19	55		 2		 T.				7			1.2		•••	0.14	
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79-8 71823 1-80 9.0 15.0 SH 100 44 23 2	0067+00;	8 -6	71822	: 1-80		••	ا ا	001	7	•••	13		Š				W					0.0		•••
79-9 71834 11-80 15.0 - 10.0 51 13 10.0 52 13.0 59.0 10.14 2538 62834 9-83 17.0 19.5 17.0 19.5 12.9 2 12.8 6.7 33.5 1 2632 82834 9-83 17.0 19.5	0067400	8	71823	08-1:		• • •	E :	3	Fi	S.	N S	4	• • •				ή (į			• •	:	
2632 92635 9-63 17-0 19-5 18-1 100 95 33 6 93.4 30.2 1-0 29 1.2 32 0.0 10.14 100 96 63 30 78.9 36.5 1-0 0.4 100 12 12 12 12 12 12 1		ב ב	1830	1-80	15.0	••	₽:		7		È	92 F. CF	 				7		Ç) ·		• •	7	
2638 182836 19-83 17.0 19-8 16-3 30 178.9 38.5 1 1-0 0.4 1 100 42 18.5 13.0 1 18.9 38.5 1 1-0 0.4 1 100 42 18.5 1 100 42 18.5 1 100 42 18.5 1 100 42 18.5 1 100 42 18.5 1 100 42 18.5 1 100 42 18.5 1 100 62 18.5 1	0067+00		71831	1-80	30.0	 :	₽ 5		χ. Σ	•••	 و م		~ .				7	_	52	1.2		•••	0.14	
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79-6 71828 1-80 0.0 4.0 ML 100 93 43 15	0048+00	2632	82834	: 8-83		••	3		22	••	32	83.9 34					7					••		
" 71829 1-80 5.0 10.0 CH 100 96 53 125	0047+00:	9-62	71828	: 1-80		••	를	100	93	••	15 :		: 5				A-R		21	·.		. 0.0		••
2634 82835 9-83 20.0 NH 100 97 61 29 71.1 49.7 2-0 0.4 29.0 24 27 27 27 27 27 27 27	0042+00	:	71829	: 1-80		••	품	100	98	••	22		š				9-E		19	0.1		0.1		
79-3 71826 1-80 1.0 4.0 CL 100 71 46 21	0030+00:	2634	82835	: 69-6:	20.0	==	₹	100	97		 53						2-C					••		••
: " ; 71827 ; 1-80 ; 6.0 9.0 ; SC ; 100 23 ; 28 ; 11 ; ; 51. 113.7 13.8 ; 94 3-R 37% 0.0 ; 2636 ; 91059 ; 12-85 ; 13.0 ; SP-SM ; 100 11 ; NP ; 97.3 23.8 ; ; 91060 ; 12-85 ; 16.0 ; SP-SM ; 100 7 ; NP ; ; 91060 ; 12-85 ; 16.0	0017+00	29-3	71826	: 1-80		••	ರ	 100 100	7	9	21:		5			٠.	<u>ج</u> ا		13	6.3		0.5		
: 2636 : 91059 :12-85 :13.0	0017+00:	=	71827	: 1-80		••	ಜ		23	:58	11 :		: 54				3-R					••		••
: . : 91060 : 12-85 : 16.0 : SP-SH: 100 7 : :	0012+00	2636	91059	: 12-85	13.0	•••	SP-SH		11	••	 ₫	97.3 23	••									••	90.0	••
	0012+00;	:	09016	: 12-85 :	16.0		SP-Sh	•••	~	••	÷		••									••		••

NOTES:

R - Remolded sample
U - Undisturbed sample
** - Direct shear test
\$ - Unconfined Compression Test
T - Test trench
Perweebilities range from 80% to 95% of max. density

TABLE 8 LOWER SANTA ANA RIVER COMPACTION TEST RESULT SUMMARY

(ASTM D 1557)

					(NO	IN D 1991		ach	. Analy	,					
				;		;			iner			٠,	Compaction		;
Chabias	•	Uala	Report		. .						; PI		Compaction	•	,
Station	į	Hole	•	•									DCE	%	i
	i	No.	Date	i From	10	! 	1#	,	#200	i 		;	PCF	Moist	i
910+00		1200	13-26-84	1 12 0	15.0		!	90	8		INP		117.2	9.7	
900+00	ļ		13-20-64			SP-SM	;	89	6		INP		117.2	10.5	
895+00	•			29.0				100	31						
	•						1	88					120.8	11.8	
	:		13-15-84			ISP-SM			12		INP		127.0	7.5	
875+00	i	-	14-5-84				1	87	7 1		INP		116.9	11.0	
	!		14-12-84					100	69				121.9	12.3	
875+00	i		4-12-84			ISM	;	66	20		: NP		135.7	7.8	
	;		14-26-84			ISP-SM	1	99	6		INP		111.8	14.1	
875+00	ì		14-29-84			:CH		100	88				97.1	19.1	
875+00	i		14-12-84			IML		100	63		INP		130.3	8.9	
820+00	:		13-29-84			ICL		100	76	-			125.2	10.2	
	;			25.5		SC	ł	64	2 2				133.5	7.0	
800+00	:			38.0				100	85 1				118.5	11.6	
789+00	ŀ		14-12-84					100	29				121.0	12.0	
719+00	ŀ		12-17-84					100	19		I NP		132.0	5.0	
719+00	:		12-17-84			SP-SM	ł	93	8		INP		115.1	7.7	1
710+00	;		12-17-84		24.0	:SP	;	96	3 ;	}	! NP	ŧ	104.4	10.7	;
699+00	:		11-18-83		12.0	ISC	ł	75	23	21	8 1	i	134.8	5.7	ì
690+00	;	1604	12-17-84	1.0	12.0	i SP	1	94	4 1	l	I NP	ï	106.7	4.6	1
680+00	ŀ	1605	;	24.0	29.0	igw-gm	:	55	10	;	I NP	i	134.0	7.3	1
646+00	;	1701	1	12.0	21.0	:SM	1	95	12	,	INP	;	120.5	4.5	1
646+00	:	1701	1	21.0	30.0	ICL	ŀ	100	70	49	1 25	;	117.0	13.5	1
622+00	;	1703	13-29-84	3.0	12.0	:SP	:	95	4 ;	}	!NP	:	111.1	13.8	;
614+00	:	1705	:	15.0	24.0	:CL	1	100	86	37	1 17	ł	115.0	14.2	1
601+50	1	1706	;	17.0	27.0	ICL	1	100	78 :	42	: 20	ŀ	114.0	15.5	
590+00	:	1707	11-5-84	1.0	15.0	ICL	:	100	61				119.3	12.1	
590+00	:	1707	;	24.0	32.0	:CL	1	100	86		1 14	:	114.2	12.9	:
561+00	:	1803	13-29-84	13.5			1	100	75				117.0	12.6	
561+00	:	1804	13-19-84	8.0				100	73		-		119.3	11.5	
561+00	:	1804	13-19-84	16.0	18.0		:	100	37		INP		119.0	11.0	
548+50	ŀ	1805		12.0	18.0	I CL		100	76				119.0	13.5	
460+00	:	1808		3.0			i	89	4		INP		104.2	3.3	
522+50	ļ	1810	11-12-84				i	97	23		I NP		116.5	6.8	
508+80	1	1902	11-12-84			ISM	i	99	14		INP		110.0	12.2	
474+00	:	1906	13-26-84	9.0			i	98	5		INP		111.2	12.5	
474+00	:			22.0			ì	100	80				119.3	11.0	
468+00	ŀ	1907	13-19-84	6.0	12.0			100	32		:NP		119.0	12.0	
468+00	;	1907		18.0			i	95	4				110.0	7.0	
460+00	:		11-12-84					100	13		INP		115.0	10.0	
460+00	:	1908		24.0				100	94				107.0	19.0	
420+00			13-26-84			ISM	i	97	12				119.8	9.0	
420+00	ŀ	2004		16.0			-	100	54				118.0	11.5	
390+00	:	2008	11-8-84				i	99	13				111.5	12.9	
390+00			13-29-84			INL	-	100	82				112.7	13.2	
390+00	i		13-26-84			IML		100	66		:		117.5	12.2	
370+00				26.5		ISM		100	23		:NP		123.9	7.9	
350+00	ì		14-9-84					100	54				125.8	9.2	
	:		13-26-84				•	98	43				121.8	11.2	
330+00			13-26-84			ISM-SM	i	94	9 :		INP		118.2	10.4	
310+00			13-26-84				;	96	20		:NP		123.2	9.2	
270+00			14-9-84					100	59				117.9	9.9	
260+00	:		11-11-84			ISM	!	99	47				117.9	8.0	
260+00	:		11-23-84			ISM-SC	•	77 100	10				120.8		
	:		11-18-84											11.8	
E04,44	•	2207	11 10 07	. 47.U		ICH	i	100	87	, 60	1 34	í	110.0	17.0	•

TABLE 9

LOWER SANTA ANA RIVER
SUMMARY GRADATION AT RIVER

													GRAIN SIZ	E IN	
	MEC	HANT	AL AN	IALYS	S (PE	RCENT	FINE	R) \$1	EVE S	12E			MILLIMET	ERS	
LOWER SANTA ANA RIVER		3.0	1.5	3/4	3/8	#4	#10	#16	#40	#100	#200	D10	D50	085	015
REACH-1															
Right Embankment	UL	100	100	99	97	94	90	82	55	33	25	0.00	0.36	1.52	0.00
Composite Summary	UQ	100	98	94	89	87	81	72	35	17	13	0.02	0.73	3.90	0.11
	AVG	99	94	90	86	82	75	66	36	17	11	0.06	0.77	8.18	0.13
	LQ	100	92	88	83	78	71	61	29	11	7	0.13	0.92	13.51	0.21
	LL	95	89	81	77	72	66	57	27	6	3	0.20	1.01	28.50	0.26
Right Embankment	UL	100	100	100	100	99	97	95	89	80	71	0.00	0.00	0.30	0.00
Frequency Summary	UQ	100	100	98	96	92	86	77	45	20	11	0.07	0.54	1.91	0.11
	AVG	99	94	90	86	82	75	66	36	17	11				
	LQ	100	93	85	81	75	67	57	26	7	4	0.19	1.02	19.05	0.26
	LL	84	45	42	38	34	31	27	9	2	1	0.46	42.98	77.18	0.68
Left Embankment	UL	100	100	100	100	100	98	96	86	62	42	0.00	0.10	0.41	0.00
Frequency Summary	UQ	100	100	97	94	90	85	75	42	21	12	0.06	0.61	2.00	0.10
	AVG	99	95	90	86	79	74	66	36	15	10				
	LQ	100	92	85	81	73	68	60	28	9	5	0.16	0.95	19.05	0.23
	LL	81	81	69	65	8	7	5	4	3	1	4.93	8.27	76.20	5.35
Foundation	UL	100	100	100	100	100	98	97	90	90	81	0.00	0.00	0.11	0.00
Frequency Summary	UQ	100	100	98	96	92	86	75	42	25	16	0.00	0.61	1.93	0.07
	AVG	99	94	89	83	77	68	59	33	19	15				
	LQ	100	93	86	77	68	57	43	17	6	4.1	0.25	1.60	17.99	0.37
	LL	67	45	42	37	31	23	16	4	1	1	0.31	46.76		1.13
Invert	UL	100	100	100	99	98	95	86	76	68	37	0.00	0.00	0.39	0.00
Frequency Summery	UQ	100	100	95	89	80	71	55	18	3	2	0.28	1.09	7.41	0.37
	AVG	96	92	88	82	75	63	49	14	3	2				
	LQ	94	89	85	74	69	59	42	8	1	0 ;	0.47	1.57	19.05	0.58
	LL	70	64	63	61	58	42	27	4	0	o i	0.62	3.38		0.79

NOTE

UL = UPPER LIMITS
UQ = UPPER QUARTILE
AVG = MEAN (AVERAGE)
LQ = LOWER QUARTILE
LL = LOWER LIMITS

TABLE 9

LOWER SANTA ANA RIVER
SUMMARY GRADATION AT RIVER

	MEC	HANIC	AL AN	IALYSI	S (PE	RCENT	FINE	R) SI	EVE S	IZE		G	RAIN SIZE MILLIMETE		
LOWER SANTA ANA RIVER		3.0	1.5	3/4	3/8	#4	#10	#16	#40	#100	#200	D10	050	D85	D15
REACH-2															
(ABOVE STA.880)											- 1				
Embankment	UL	100	100	100	100	100	100	99	96	89	84	0.00	0.00	0.09	0.00
Frequency Summary	UQ	100	100	99	98	95	91	84	56	26	16	0.00	0.37	1.31	0.07
	AVG	100	99	96	93	90	85	78	48	23	14				
	LQ	100	100	95	92	88	82	74	38	14	8	0.10	0.68	3.38	0.16
	LL	79	65	60	57	53	44	38	11	4	2	0.38	3.84	92.53	0.53
Embankment	UL	100	100	98	97	95	92	86	62	44	34 I	0.00	0.24	1.15	0.00
Composite Summary	UQ	100	100	98	95	92	86	80	54	27	15	0.00	0.38	1.89	0.07
,	AVG	100	99	96	93	90	85	78	48	23	14 j	0.04	0.47	2.14	0.09
	LQ	100	97	94	91	87	83	75	44	17	11 İ	0.05	0.57	3.30	0.13
	LL	96	95	93	89	83	77	67	34	11	6	0.14	0.80	6.41	0.20
Foundation	UL	100	100	100	100	100	100	99	96	88	75 I	0.00	0.00	0.13	0.00
Frequency Summary	UQ	100	100	100	98	96	91	85	51	23	15 i	0.00	0.41	1.19	0.07
	AVG	99	97	94	90	86	79	71	41	22	16				
	L6	100	96	92	87	82	69	58	25	8	4 j	0.18	1.00	7.62	0.26
	LL	74	65	51	40	31	23	17	8	1	0 j	0.59	18.18		1.02
Invert	UL	100	100	98	91	79	62	43	19	7	4 1	0.22	1.49	7.14	0.33
Frequency Summary	UQ	100	100	95	85	72	54	41	17	4	3 1	0.27	1.75	9.53	0.38
- 4 , ,	AVG	94	91	82	74	64	50	38	12	3	2 1				
	LO	100	81	71	63	55	46	38	9	2	1 1	0.45	3.23	76.20	0.58
	LL	74	69	62	54	47	39	30	8	1	o i	0.49	6.80		0.67

NOTE

UL = UPPER LIMITS
UQ = UPPER QUARTILE
AVG = MEAN (AVERAGE)
LQ = LOWER QUARTILE

LL = LOWER LIMITS

TABLE 9

LOWER SANTA ANA RIVER
SUMMARY GRADATION AT RIVER

LOWER SANTA ANA RIVER	MECHANICAL ANALYSIS (PERCENT FINER) SIEVE SIZE											GRAIN SIZE IN MILLIMETERS			
		3.0	1.5	3/4	3/8	#4	#10	#16	#40	#100	#200	D10	050	085	D15
REACH-2											ŀ				
(BELOW STA.880)											1				
Embankment	UL	100	100	100	100	100	100	99	96	89	71	0.00	0.00	0.13	0.00
Frequency Summary	UQ	100	100	100	99	97	93	85	52	19	12	0.05	0.40	1.19	0.11
	AVG	100	99	97	95	92	87	78	46	19	12				
	LQ	100	100	97	94	90	84	73	37	9	4	0.16	0.70	2,46	0.21
	LL	80	75	69	63	49	40	32	6	0	0	0.54	5.10		0.69
Embankment	UL	100	100	100	100	99	96	90	63	43	34	0.00	0.25	1.04	0.00
Composite Summary	UQ	100	100	99	98	96	91	83	51	20	13	0.04	0.41	1.42	0.09
	AVG	100	99	97	95	92	87	78	46	19	12 j	0.05	0.52	1.83	0.11
	LQ	100	99	95	92	88	83	74	37	10	5 j	0.14	0.69	3.15	0.20
	LL	98	92	89	82	73	64	50	13	1	0	0.35	1.19	13.61	0.46
Foundation	UL	100	100	100	100	100	100	100	99	96	92	0.00	0.00	0.00	0.00
Frequency Summary	UQ	100	100	100	100	99	97	93	73	48	31	0.00	0.17	0.88	0.00
	AVG	100	98	95	91	87	83	76	51	29	22				
	LQ	100	98	95	91	85	76	66	31	8	4	0.17	0.84	4.76	0.23
	LL	76	70	56	44	33	26	22	8	1	o į	0.53	14.29		0.81
Invert	UL	100	100	100	100	100	99	97	90	85	84	0.00	0.00	0.15	0.00
Frequency Summary	UQ	100	100	100	99	97	92	82	37	12	5	0.13	0.64	1.43	0.18
	AVG	100	98	95	92	87	81	72	35	13	8				
	LQ	100	97	91	89	84	76	64	21	2	1 (0.26	0.94	5.71	0.33
	LL	87	80	75	60	48	42	33	6	0	o i	0.53	5.55	65.31	0.68

NOTE

UL = UPPER LIMITS
UQ = UPPER QUARTILE
AVG = MEAN (AVERAGE)
LQ = LOWER QUARTILE
LL = LOWER LIMITS

TABLE 9 LOWER SANTA ANA RIVER SUMMARY GRADATION AT RIVER

	MEC	:HAN I C	CAL AN	IALYS1	S (PE	RCENT	FINE	R) SI	EVE S	IZE		_	RAIN SIZE MILLIMETE		
LOWER SANTA ANA RIVER		3.0	1.5	3/4	3/8	#4	#10	#16	#40	#100	#200	D10	D50	D85	D15
REACH-3															
Embankment	UL	100	100	100	100	100	100	100	99	93	90	0.00	0.00	0.00	0.00
Frequency Summary	UQ	100	100	100	100	99	98	91	74	42	31 j	0.00	0.22	0.92	0.00
	AVG	100	99	99	98	96	93	77	58	29	21				
	LQ	100	100	99	98	96	91	67	41	9	4	0.16	0.69	1,80	0.20
	LL	99	78	66	62	54	43	35	19	1	0	0.28	3.76	50.80	0.36
Embankment	UL	100	100	100	100	100	97	94	92	77	64	0.00	0.00	0.30	0.00
Composite Summary	UQ	100	100	100	99	98	96	87	62	25	18 j	0.00	0.33	1.14	0.04
	AVG	100	99	99	98	96	93	77	58	29	21	0.00	0.35	1.61	0.01
	LQ	100	99	99	98	96	92	71	47	13	8	0.10	0.53	1.73	0.16
	LL	100	95	91	89	85	78	62	32	1	o j	0.23	0.88	4.62	0.27
Foundation	UL	100	100	100	100	100	100	100	100	99	99	0.00	0.15	0.15	0.00
Frequency Summary	UQ	100	100	100	100	100	99	98	98	91	80	0.00	0.00	0.11	0.00
	AVG	100	99	98	97	95	93	88	79	62	51 [
	LQ	100	100	100	94	98	95	81	58	29	12	0.07	0.35	1.42	0.09
	LL	95	82	64	48	35	26	20	14	1	0	0.34	10.72	46.89	0.55
Invert	UL	100	100	100	100	100	99	99	98	96	94	0.00	0.00	0.00	0.00
Frequency Summary	UQ	100	100	100	100	100	98	97	87	68	51	0.00	0.07	0.39	0.00
	AVG	99	99	98	97	96	92	87	56	33	27				
	LQ	100	100	99	97	95	88	81	30	3	2	0.22	0.72	1.65	0.27
	LL	95	92	89	79	69	55	40	6	0	0	0.51	1.73	15.24	0.62

UL = UPPER LIMITS UQ = UPPER QUARTILE

AVG = MEAN (AVERAGE)

LQ = LL = LOWER QUARTILE

LOWER LIMITS

TABLE 9

LOWER SANTA ANA RIVER
SUMMARY GRADATION AT RIVER

												GI	RAIN SIZE	IN	
	MEC	HANIC	AL AN	IALYSI	S (PE	RCENT	FINE	R) SI	EVE S	IZE		1	MILLIMETE	RS	
LOWER SANTA ANA RIVER		3.0	1.5	3/4	3/8	#4	#10	#16	#40	#100	#200	D10	D50	D85	D15
REACH-4											ł				
Embankment	UL	100	100	100	100	100	100	100	99	93	90	0.00	0.00	0.00	0.00
Frequency Summary	UQ	100	100	100	100	100	100	99	96	78	58	0.00	0.04	0.25	0.00
	AVG	100	100	99	98	97	95	93	79	49	34				
	LQ.	100	100	100	99	98	95	91	66	23	10	0.07	0.32	1.01	0.10
	LL	100	94	88	81	70	53	42	20	6	3	0.23	1.78	14.97	0.32
Embenkment	UL	100	100	100	100	100	100	100	98	87	68	0.00	0.00	0.14	0.00
Composite Summary	UQ	100	100	100	99	99	97	94	83	55	39	0.00	0.12	0.54	0.00
•	AVG	100	100	99	98	97	95	93	79	49	34	0.00	0.16	0.74	0.00
	LQ	100	100	99	98	96	94	91	73	31	21	0.00	0.27	0.93	0.04
	LL	100	99	96	93	90	86	79	52	21	8	0.09	0.40	1.88	0.12
Foundation	UL	100	100	100	100	100	100	100	100	99	99	0.00	0.15	0.15	0.00
Frequency Summary	UQ	100	100	100	100	100	100	100	98	92	82	0.00	0.00	0.10	0.00
• •	AVG	100	100	100	100	100	98	98	94	80	68				
	LQ	100	100	100	100	100	98	98	93	73	57	0.00	0.04	0.31	0.00
	LL	100	91	91	83	71	63	56	41	19	10	0.07	0.88	11.91	0.12
Invert	UL	100	100	100	100	100	100	99	96	76	43	0.00	0.09	0.27	0.00
Frequency Summary	UQ	100	100	100	100	100	94	92	62	14	9	0.09	0.35	1.01	0.15
•	AVG	100	100	100	99	98	94	91	67	25	15				
	LQ	100	100	100	100	100	94	92	62	12	9 j	0.10	0.35	1.01	0.17
	LĻ	100	100	98	95	92	87	80	51	12	4 [0.13	0.41	1.77	0.17

UL = UPPER LIMITS
UQ = UPPER QUARTILE
AVG = MEAN (AVERAGE)
LQ = LOWER QUARTILE
LL = LOWER LIMITS

TABLE 9

LOWER SANTA ANA RIVER
SUMMARY GRADATION AT RIVER

	MEC	HANIC	AL AN	IALYSI	S (PE	RCENT	FINE	R) SI	EVE S	IZE		_	RAIN SIZE HILLIMETE	• • • • • • • • • • • • • • • • • • • •	
LOWER SANTA ANA RIVER		3.0	1.5	3/4	3/8	*	#10	#16	#40	#100	#200	D10	D50	D85	D15
REACH-5															
(ABOVE STA.350)															
Embankment	UL	100	100	100	100	100	99	98	93	60	36	0.00	0.12	0.36	0.00
Composite Summary	UQ	100	100	100	99	99	97	94	75	39	21	0.00	0.23	0.81	0.05
	AVG	100	100	99	99	98	95	90	70	34	18	0.00	0.27	1.00	0.06
	LQ	100	100	99	98	97	94	89	67	27	14	0.05	0.31	1.05	0.08
	LL	100	99	98	96	94	91	69	47	16	7	0.10	0.51	1.79	0.14
Foundation	UL	100	100	100	100	100	100	100	100	100	100	0.00	0.15	0.15	0.00
Frequency Summary	UQ	100	100	100	100	100	100	99	97	87	71	0.00	0.00	0.14	0.00
	AVG	100	100	99	99	98	96	93	77	50	38				
	LQ	100	100	100	100	99	97	92	57	14	7	0.11	0.38	1.04	0.16
	LL	100	80	64	63	41	40	37	14	1	0	0.34	6.71	47.63	0.45
Invert	UL	100	100	100	100	100	99	98	96	89	81	0.00	0.00	0.11	0.00
Frequency Summary	UQ	100	100	100	100	99	98	98	96	89	81	0.00	0.00	0.11	0.00
	AVG	100	100	99	98	95	89	84	57	35	31				
	LQ	100	100	99	98	95	82	70	33	2	1	0.22	0.77	2.64	0.26
	LL	100	96	87	73	64	56	50	14	1	0	0.34	1.19	17.69	0.44
REACH-5															
(BELOW STA.350)															
Embankment	UL	100	100	100	100	100	100	99	93	69	44	0.00	0.09	0.33	0.00
Composite Summary	UQ	100	100	100	100	99	98	97	85	52	30	0.00	0.14	0.45	0.00
	AVG	100	100	100	99	99	97	95	76	41	24	0.00	0.22	0.79	0.04
	LQ	100	100	99	99	98	96	91	61	25	13	0.06	0.34	1.04	0.09
	LL	100	99	97	95	89	71	53	17	. 1	1	0.30	1.13	4.15	0.39
Foundation	UL	100	100	100	100	100	100	100	100	99	96	0.00	0.00	0.00	0.00
Frequency Summary	UQ	100	100	100	100	100	100	100	98	89	66	0.00	0.02	0.14	0.00
	AVG	100	100	100	100	99	99	98	88	63	44				
	LQ	100	100	100	100	100	99	98	88	42	16	0.00	0.20	0.40	0.07
	LL	100	93	89	83	79	71	53	17	1	1	0.30	1.13	12.70	0.39
Invert	UL	100	100	100	100	100	100	100	99	95	93	0.00	0.00	0.00	0.00
Frequency Summary	UQ	100	100	100	100	100	100	99	92	48	16	0.00	0.16	0.38	0.07
	AVG	100	100	99	98	97	94	90	66	28	15				
	LQ	100	100	99	97	94	89	81	43	7	2	0.17	0.56	1.60	0.21
	LL	100	93	91	90	88	71	53	17	1	1	0.30	1.13	4.27	0.39

UL = UPPER LIMITS
UQ = UPPER QUARTILE
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LL = LOWER LIMITS

TABLE 9

LOWER SANTA AMA RIVER
SUMMARY GRADATION AT RIVER

	MEC	HANIC	CAL AN	IALYSI	S (PE	RCENT	FINE	R) SI	eve s	IZE			RAIN SIZE MILLIMETE	•	
LOWER SANTA ANA RIVER		3.0	1.5	3/4	3/8	#4	#10	#16	#40	#100	#200	D10	D50	D85	D15
REACH-6											- 1				
Embankment	UL	100	100	100	100	100	100	100	98	95	84	0.00	0.00	0.08	0.00
Composite Summary	UQ	100	100	100	100	100	100	99	94	75	62	0.00	0.01	0.29	0.00
	AVG	100	100	100	100	100	99	99	90	63	44	0.00	0.10	0.37	0.00
	LQ	100	100	100	100	100	99	98	87	59	40	0.00	0.11	0.40	0.00
	LL	100	100	100	100	99	99	97	83	46	26	0.00	0.18	0.55	0.04
Foundation	UL	100	100	100	100	100	100	100	100	99	99 {	0.00	0.15	0.15	0.00
Frequency Summary	UQ	100	100	100	100	100	100	100	99	95	83	0.00	0.00	0.09	0.00
	AVG	100	100	100	100	100	98	97	95	74	51 j				****
	LQ	100	100	100	100	100	99	98	95	65	16 j	0.00	0.13	0.33	0.07
	LL	100	100	100	95	87	78	73	58	6	1 [0.17	0.38	4.15	0.20
REACH-7												•			
Embankment	UL	100	100	100	100	100	100	100	100	97	88 i	0.00	0.00	0.05	0.00
Composite Summery	UQ	100	100	100	100	100	100	99	98	80	55 İ	0.00	0.06	0.22	0.00
•	AVG	100	100	100	99	99	98	97	89	61	42	0.00	0.11	0.38	0.00
	LQ	100	100	100	99	98	97	95	89	44	22	0.00	0.19	0.40	0.05
	LL	100	100	99	98	97	94	92	62	4	1	0.18	0.36	1.02	0.20
Foundation	UL	100	100	100	100	100	100	100	100	99	98	0.00	0.00	0.00	0.00
Frequency Summary	UQ	100	100	100	100	100	100	100	98	63	10 j	0.07	0.13	0.32	0.08
	AVG	100	100	100	100	99	97	95	83	37	12				
	LQ	100	100	100	100	99	97	93	78	16	3	0.11	0.30	0.78	0.14
	LL	100	100	97	91	83	77	67	24	3	1	0.24	0.89	5.95	0.30

UL = UPPER LIMITS
UQ = UPPER QUARTILE
AVG = MEAN (AVERAGE)
LQ = LOMER QUARTILE

LL = LOWER LIMITS

TABLE 9

LOWER SANTA ANA RIVER
SUMMARY GRADATION AT RIVER

	MEC	HANIC	AL AN	IALYSI	S (PE	RCENT	FINE	R) SI	EVE S	IZE			RAIN SIZE MILLIMETE		
LOWER SANTA ANA RIVER		3.0	1.5	3/4	3/8	#4	#10	#16	#40	#100	#200	D10	D 50	D85	D15
DROP STRUCTURE FOUNDATION FREQUENCY SUMMARIES											 				
STA.875+40	UL	100	100	100	100	100	99	97	92	83	81	0.00	0.00	0.21	0.00
	UQ	100	100	99	98	97	90	81	45	21	15 j	0.00	0.53	1.55	0.07
	AVG	99	97	94	90	86	79	70	42	22	16 j				
*	LQ	100	96	94	90	85	74	65	29	12	7 j	0.12	0.87	4.76	0.20
	LL	87	80	75	60	48	42	33	13	1	o į	0.35	5.55	65.31	0.50
STA .1023+50	UL	100	100	100	100	100	99	98	92	88	75	0.00	0.00	0.13	0.00
	UQ	100	100	100	100	99	98	95	86	67	55	0.00	0.04	0.41	0.00
	AVG	99	94	90	87	84	81	75	55	38	30				
	LQ	100	94	77	71	63	57	50	25	9	6	0.17	1.19	28.01	0.25
	LL	84	65	51	40	31	23	17	9	5	3	0.52	18.18	78.21	1.00
STA. 1098+50	UL	100	100	100	99	98	95	92	84	82	81	0.00	0.00	0.52	0.00
	UQ	100	100	99	96	92	84	76	27	13	10	0.07	0.78	2.35	0.19
	AVG	99	94	89	83	72	64	54	28	18	15				
	LQ	100	94	86	81	67	54	41	16	5	3	0.27	1.75	17.15	0.40
	EL	90	55	43	37	8	7	5	4	3	2	5.09	30.16	70.76	5.91
STA. 1148+60	UL	100	100	98	97	96	92	87	68	44	39	0.00	0.22	1.11	0.00
	UQ	100	100	97	93	85	80	65	32	20	6	0.10	0.84	4.76	0.12
	AVG	97	93	88	82	74	64	52	25	12	9				
	LQ	100	93	88	78	67	57	34	14	5	3 j	0.30	1.75	16.19	0.46
•	LL	67	59	50	44	40	34	26	6	2	1 j	0.57	19.05		0.77

UL = UPPER LIMITS
UQ = UPPER QUARTILE
AVG = MEAN (AVERAGE)
LQ = LOMER QUARTILE
LL = LOMER LIMITS

TABLE 9

LOWER SANTA AMA RIVER
SUMMARY GRADATION AT RIVER

	IN SIZE IN LLIMETERS
LOWER SANTA ANA RIVER 3.0 1.5 3/4 3/8 #4 #10 #16 #40 #100 #200 D10	D50 D85 D15
INVERT BORROW COMPOSITE SUMMARIES	
STA. 1207 TO 1075 UL 100 100 99 95 90 78 57 18 4 3 0.27	1.05 3.61 0.36
5FT.DEPTH UQ 100 99 95 88 81 70 55 17 3 2 0.28	1.08 7.51 0.38
AVG 100 97 92 84 74 60 43 11 3 1 0.38	1.52 10.65 0.51
LQ 100 93 88 77 68 55 41 8 1 1 0.47	1.70 16.79 0.59
LL 87 80 73 70 66 51 38 6 1 0 0.52	1.94 65.31 0.64
STA. 509 TO 398 UL 100 100 100 100 100 99 98 82 61 0.00	0.04 0.20 0.00
7FT.DEPTH U9 100 100 100 98 94 86 52 12 9 0.11	0.41 1.17 0.17
AVG 100 100 99 98 95 89 84 60 35 26 0.00	0.31 1.34 0.00
La 100 99 98 92 88 82 74 29 2 1 0.23	0.77 3.20 0.28
LL 100 96 87 73 64 56 50 14 1 0 0.34	1.19 17.69 0.44
STA. 393 TO 356 UL 100 100 100 100 99 95 38 2 1 0.21	0.53 1.05 0.25
5FT.DEPTH UQ 100 100 100 99 98 93 37 1 1 0.21	0.60 1.08 0.25
AVG 100 100 100 99 98 95 89 37 2 0 0.21	0.61 1.13 0.25
LQ 100 100 100 99 97 95 89 34 1 0 0.22	0.64 1.13 0.26
LL 100 100 100 99 97 93 87 33 1 0 0.23	0.66 1.16 0.27
STA. 354 TO 261 UL 100 100 100 99 96 92 88 60 26 15 0.00	0.34 1.10 0.07
7FT.DEPTH UQ 100 100 99 98 95 92 87 56 14 6 0.11	0.38 1.15 0.15
AVG 100 99 98 97 94 89 81 44 11 6 0.13	0.54 1.58 0.18
LQ 100 99 97 96 94 89 78 34 6 3 0.18	0.71 1.72 0.23
LL 100 97 96 95 91 80 67 27 5 2 0.22	0.86 3.25 0.28
STA.219 TO 215 UL 100 100 99 99 98 96 86 60 40 0.00	0.11 0.41 0.00
13FT.DEPTH UQ 100 100 99 98 97 96 95 85 59 40 0.00	0.11 0.45 0.00
AVG 100 99 97 96 95 94 93 83 59 39 0.00	0.12 0.60 0.00
L9 100 99 97 95 94 93 92 82 58 38 0.00	0.12 0.66 0.00
LL 100 99 96 94 92 92 90 80 57 37 0.00	0.12 0.78 0.00
STA. 132 TO 91 UL 100 100 100 100 100 99 92 69 55 0.00	0.05 0.34 0.00
8FT.DEPTH UQ 100 100 100 100 100 99 90 61 50 0.00	0.07 0.37 0.00
AVG 100 100 100 100 99 98 86 53 44 0.00	0.13 0.41 0.00
L9 100 100 100 100 99 99 97 81 41 37 0.00	0.21 0.62 0.00
LL 100 100 100 100 99 97 95 79 8 2 0.16	0.31 0.69 0.17
STA. 77 TO 13 UL 100 100 100 100 100 100 100 100 99 0.00	0.00 0.00 0.00
10FT.DEPTH UQ 100 100 100 100 100 100 100 90 74 0.00	0.02 0.13 0.00
AVG 100 100 100 100 100 99 96 74 57 0.01	0.06 0.23 0.02
L9 100 100 100 100 100 100 98 93 57 35 0.03	0.13 0.27 0.04
LL 100 100 100 100 99 97 95 89 46 13 0.07	0.16 0.03 0.08

UL = UPPER LIMITS
UQ = UPPER QUARTILE
AVG = MEAN (AVERAGE)
LQ = LOWER QUARTILE
LL = LOWER LIMITS

Table 10. Lower Santa Ana River. Potential Stone Sources - Quality Compliance Test Results.

Stone Source	Specifi Rock Type (fic Gravity Bulk (SSD)	<u>y</u> Apparent	Absorption (%)	Sulfate Soundness (\$ loss)	Abrasion (% loss)	Date ¹ Tested	Remarks ²
			Coun	Commercial Qu	Quarries			
Atkinson	Monzonite/ Monzodiorite	2.76	2.77	0.1	2.0	25.2	6/85	Sepulveda Basin
Corona-Pacific	Tonalite	2.67	2.68	0.3	0.5	14.1	4/88	San Pedro Breakwater
Declezville	Granodlorite	2.77	2.79	0.3	2.3	46.5	11/83	Morro Bay North and South Breakwaters.
ron Fish Canyon	Granite	2.74	2.76	4.0	1.53	16.9	11/86	Redondo Beach (King Harbor) North Breakwater
Harlow	Andesite	2.66	2.66	0.2	1.6	14.3	6/85	Warm Creek-Santa
Pebbly Beach	Meta-Cgl. Graywacke Meta-Volcanic	2.67 2.64 2.66	2.71 2.65 2.68	8.00	34.8 4.7	43.4 15.3 20.7	10/86 10/86 10/86	Ana Alver Confluence Port San Luis Breakwater, San Pedro & Middle Breakwaters
Slover Mtn.	Marble Metasediment	2.72	2.73	0.5	1.0	38.0	11/83	Morro Bay North Breakwater
Stringfellow	Granite	5.66	2.67	0.2	η.ο	18.3	6/85	San Pedro Breakwater
3 x	Andesite	5.69	2.70	π.0	0.5	10.0	9/83	Dana Point Breakwater

Table 10. (Continued)

	Speci	Specific Gravity	εy	Absorp-	Sulfate		*
Stone Source	Rock Type	Bulk (SSD)	Apparent	tion (%)	Soundness (% loss)	Abrasion (% loss)	Date' Tested
			X	Existing Levees	vees		
Reach 1	Granite/ Granodiorite	2.68	2.69	0.2	2.6	31.3	2/88
	Meta-Andesite Sandstone	2.61 2.53	2.64 2.55	0.7			
Reach 2	Diorite	2.75	2.76	0.2	2.0	20.8	2/88
	Granodiorite	5.69	2.70	0.2			
	Gabbro/Meta-	2.78	2.79	0.3			
	Meta-Dacite	2.67	2.68	0.1			
	Meta-Andesite	2.63	2.63	0.1			
Reach 3	Diorite	2.73	2.73	0.1	9.0	15.3	2/88
	Monzodiorite	2.72	2.72	0.1			
	Granodiorite	2.59	2.59	0.2			
	Meta-Andesite	2.73	2.74	0.3		•	

1. Only the most recent test results are shown for each stone source.

2. Rock from Harlow Quarry was only suitable for use as grouted stone on the Warm Creek-Santa Ana River Confluence project due to 50 percent failure during the wetting and drying test. The Declezville and Pebbly Beach Quarries have provided suitable rock for Corps of Engineers projects based on service records.

3. April 1982 test.

Table 11. Lower Santa Ana River.

Composite Gradation of Proposed Disposal Beach

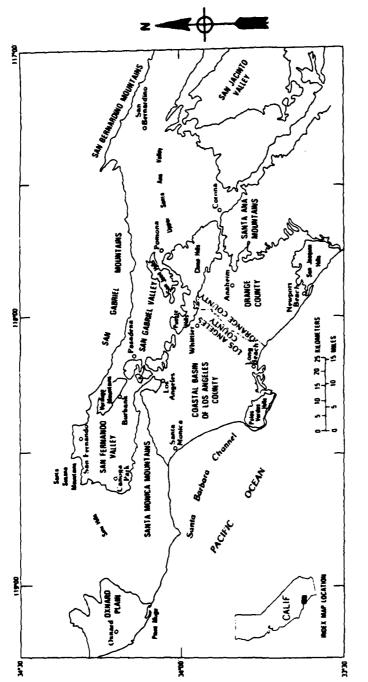
Range					Perc	ent F	'iner	- Pas	sing	Sie	eve l	iumbe	er	
Station	4	7	10	14	18	25	35	45	60			120		200
107+84	97	93	92	90	87	84	79	72	62	56	54	48	28	19
117+83	100	100	100	100	99	97	89	77	65	59	58	50	29	15
127+84	100	100	100	95	94	90	83	73	62	58	57	48	25	12
137+84	100	99	99	98	95	91	79	66	51	42	40	35	22	9
147+84	100	100	100	100	99	97	91	81	68	57	53	46	28	11
157+84	100	100	100	99	98	97	90	81	70	61	60	55	33	15
167+85	100	100	100	100	99	97	91	81	66	58	56	50	32	16
177+86	100	100	100	99	98	96	90	82	68	58	54	48	30	14
187+84	100	100	100	99	96	89	75	61	45	31	27	20	10	3
197+87	100	99	98	96	93	88	80	68	56	50	47	39	19	9
207+87	100	100	100	98	97	95	88	77	59	42	36	30	17	7
217+87	100	100	100	99	98	95	89	79	65	55	49	38	19	8
227+87	100	98	98	96	94	90	83	73	61	52	49	40	21	10
237+87	100	100	100	99	97	93	85	75	69	58	54	44	22	11
247+87	100	100	99	98	95	90	78	65	54	44	40	30	15	7
267+88	100	100	100	100	99	95	83	65	48	40	38	31	15	8
307+88	100	100	100	99	98	95	84	66	45	36	33	23	10	6
367+85	100	100	100	99	99	97	89	75	63	47	39	28	14	8

Table 11. (Continued)

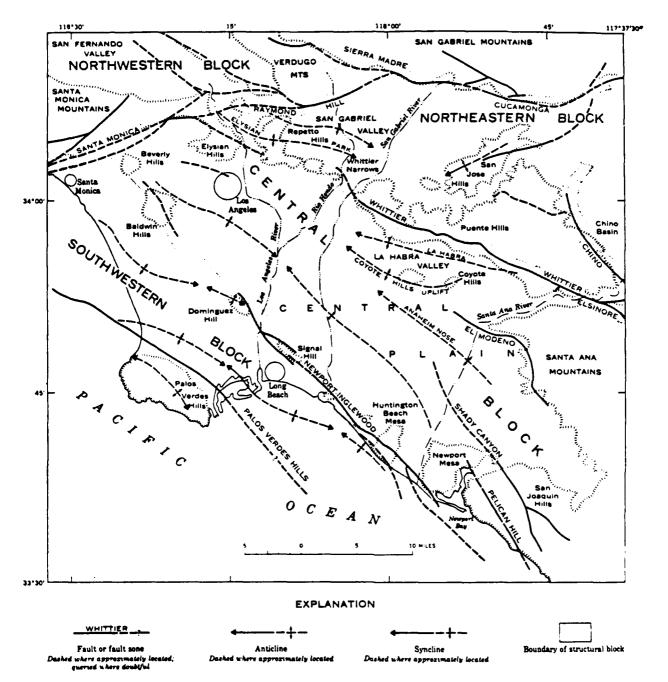
Range					Perce	nt F	iner	- Pa	ssing	Sie	eve N	lumbe	er	
Station	4	7	10	14	18	25	35	45	60	80	100	120	170	200
477+12	100	100	99	99	97	94	85	74	67	60	57	47	30	18
547+84	100	100	100	100	99	98	93	86	78	64	58	45	30	18
649+31	100	100	100	100	100	98	94	86	72	54	51	43	37	29
750+94	100	100	100	100	100	100	100	96	86	70	59	44	24	17
840+44	100	100	100	98	96	89	79	68	58	56	42	15	10	9
899+53	100	100	100	99	98	94	85	71	54	41	37	24	8	6

A GEOTECHNICAL

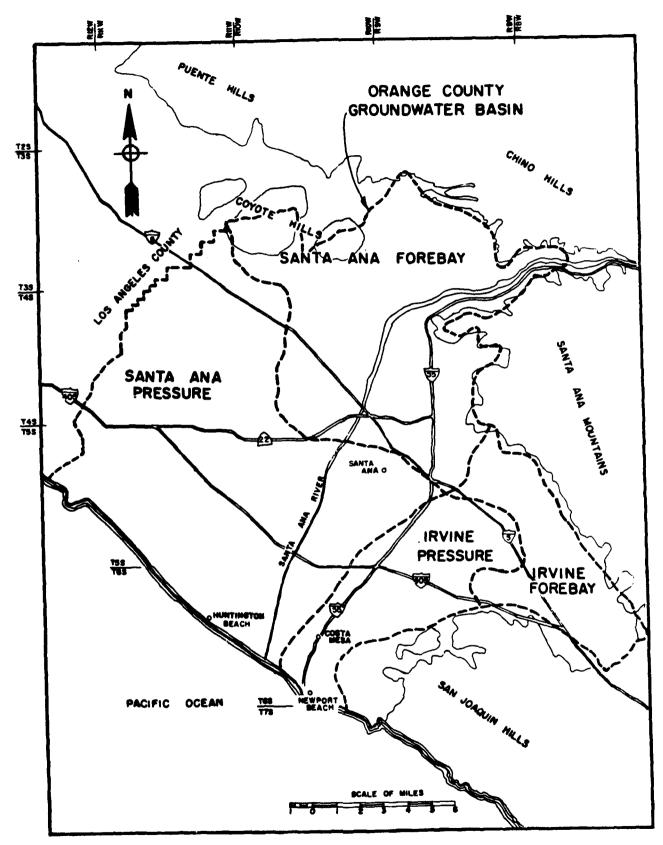
FIGURES



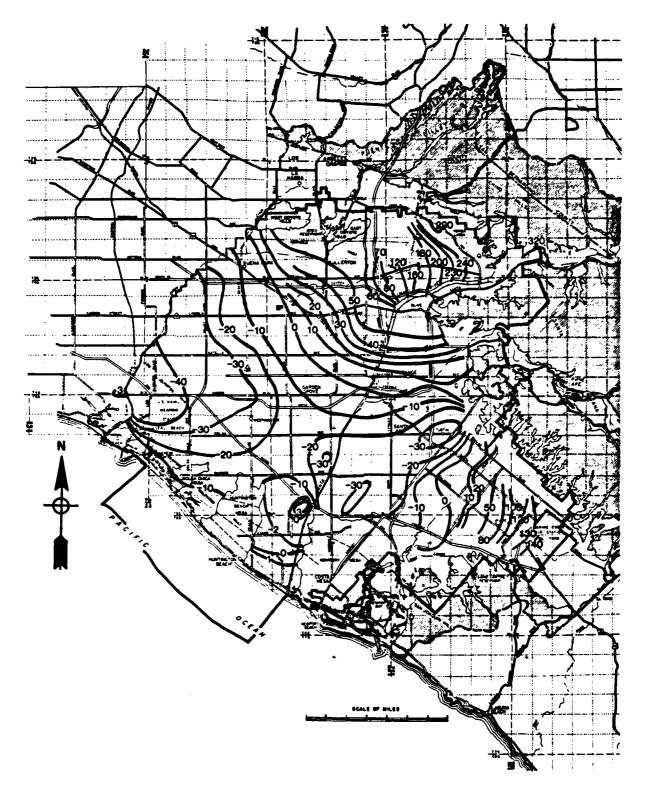
INDEX MAP OF THE LOS ANGELES REGION SHOWING MAJOR ALLUVIAL BASINS (FROM TINSLEY AND FUMAL, 1985)



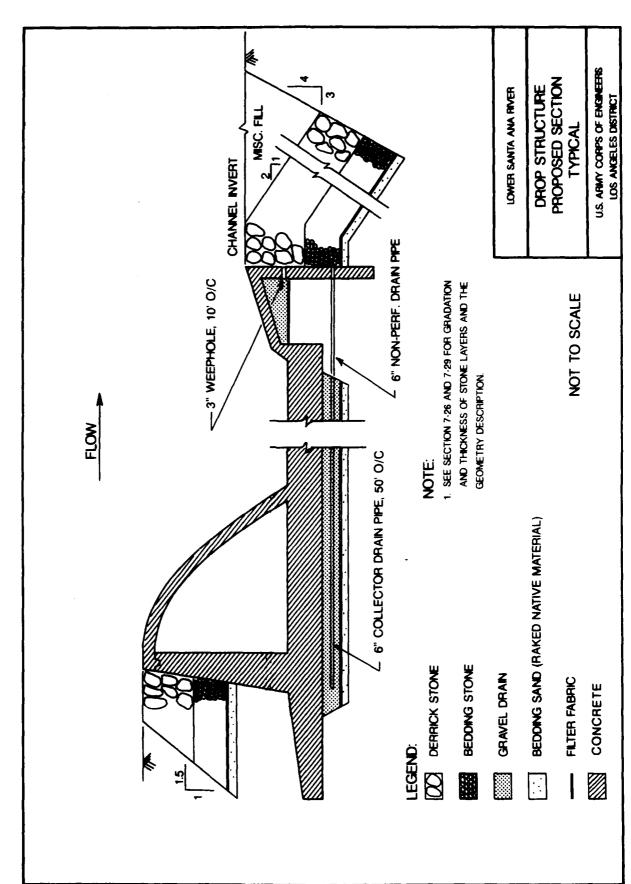
GENERAL PHYSIOGRAPHY AND STRUCTURAL FEATURES
OF THE LOS ANGELES BASIN (YERKES AND OTHERS, 1965)

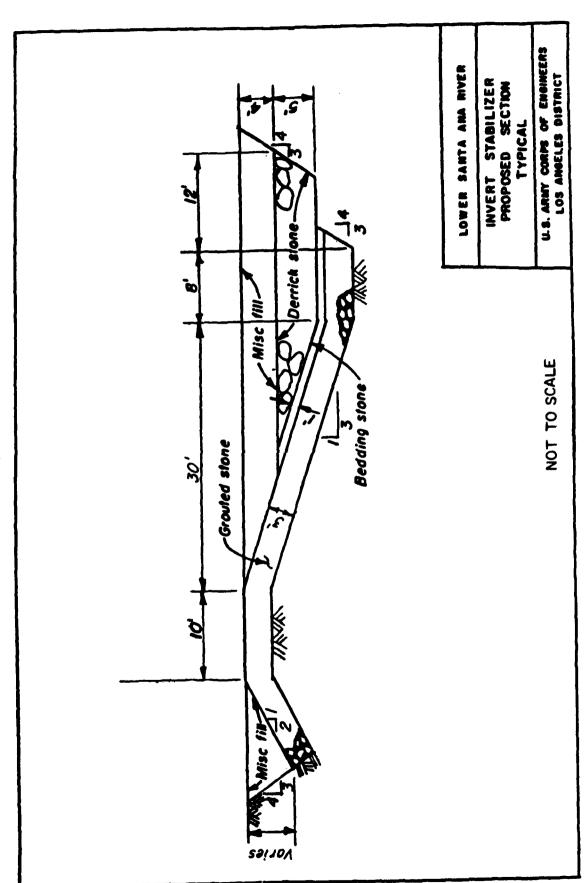


ORANGE COUNTY GROUNDWATER BASIN



ORANGE COUNTY GROUNDWATER BASIN - GROUNDWATER CONTOUR MAP, NOVEMBER 1, 1986 (FROM OCWD, 1987)

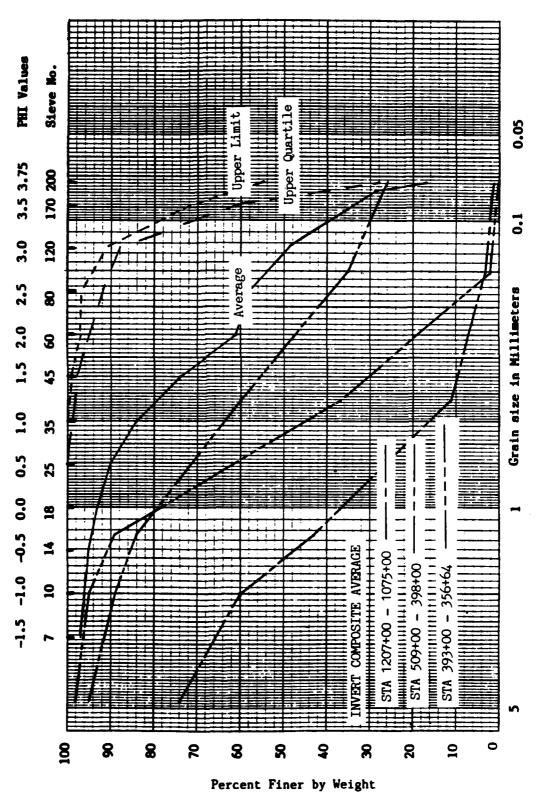




F 6.1

LOWER SANTA ANA RIVER BEACH COMPATIBILITY COMPOSITE BEACH GRADATIONS

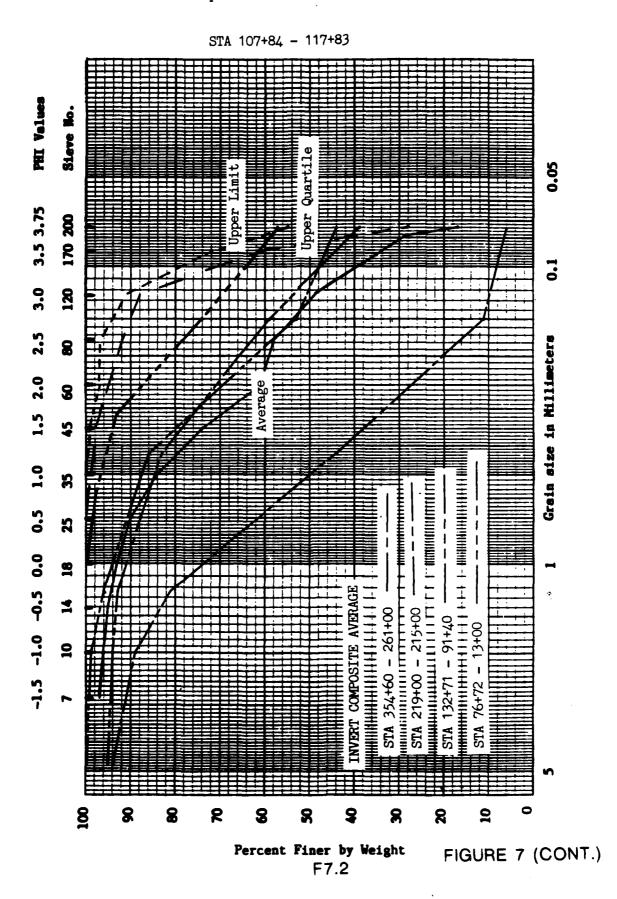
STA 107+84 - 117+83



F7.1

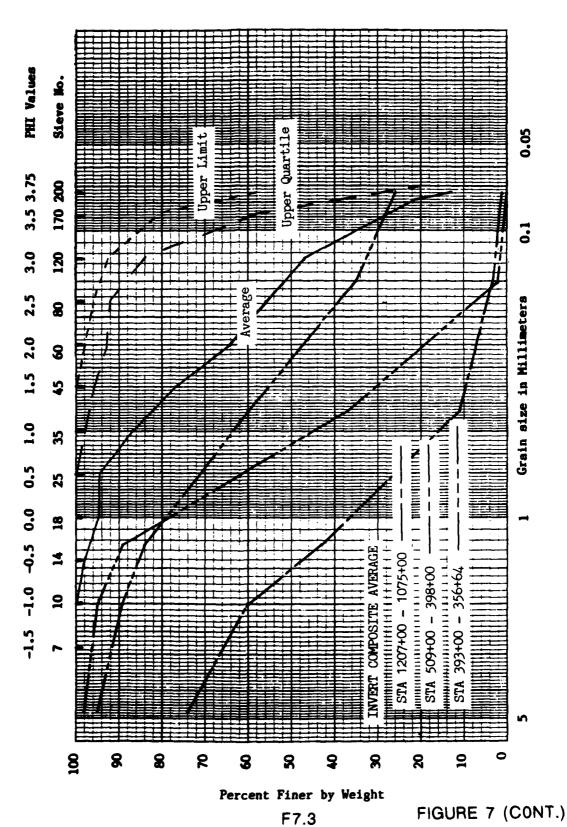
FIGURE 7-A

Lower Santa Ana River Beach Compatibility Composite Beach Gradations



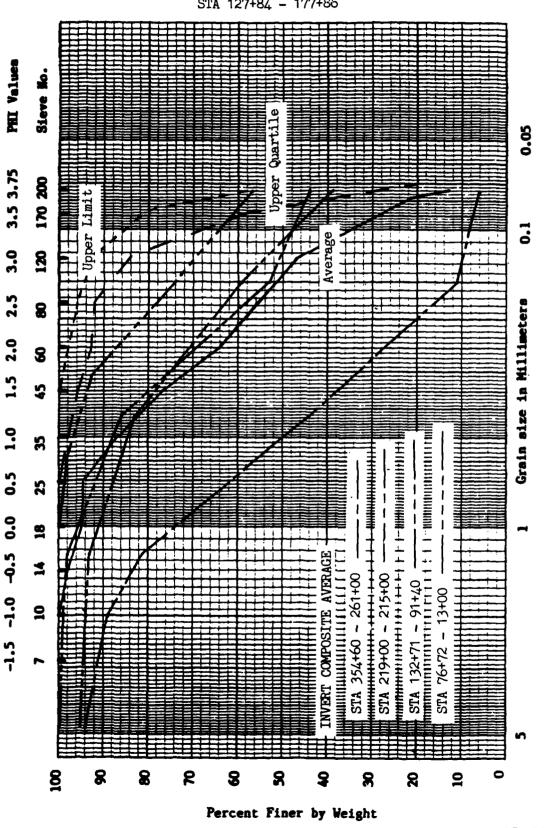
LOWER SANTA ANA RIVER BEACH COMPATIBILITY COMPOSITE BEACH GRADATIONS

STA 127+84 - 177+86



Lower Santa Ana River Beach Compatibility Composite Beach Gradations

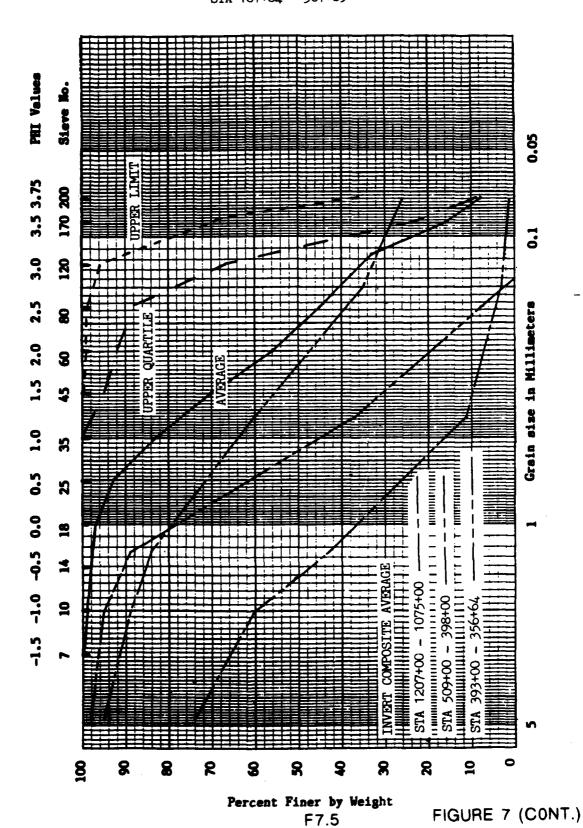
STA 127+84 - 177+86



F7.4

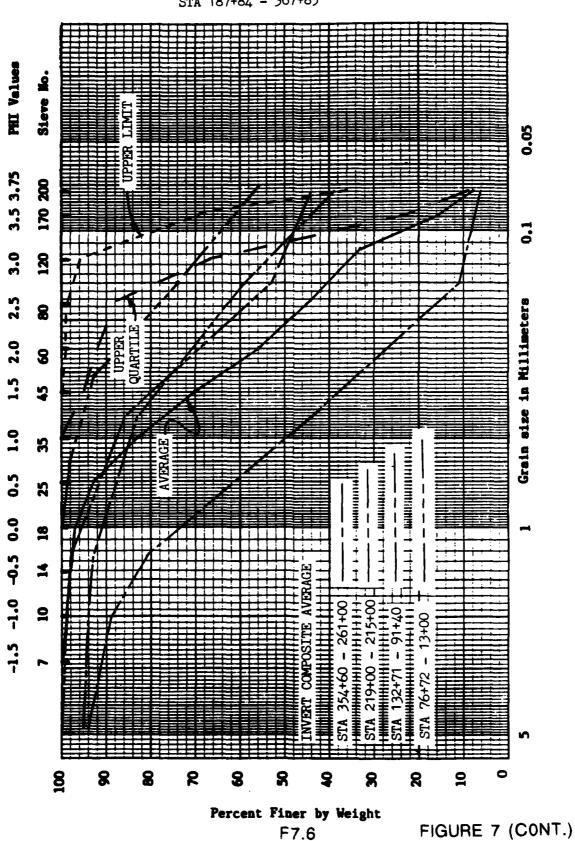
FIGURE 7 (CONT.)

LCWER SANTA ANA RIVER BEACH COMPATIBILITY COMPOSITE BEACH GRADATIONS STA 187+84 - 367+85



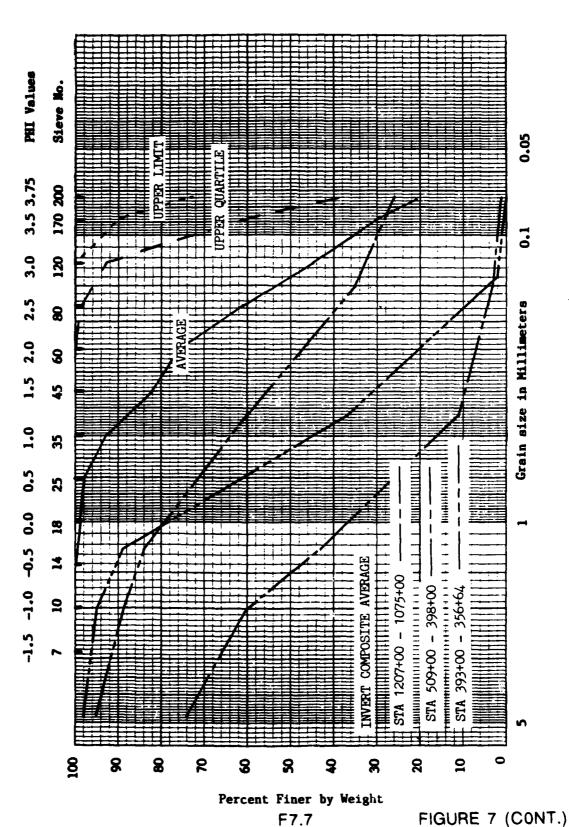
Lower Santa Ana River Beach Compatibility Composite Beach Gradations

STA 187+84 - 367+85



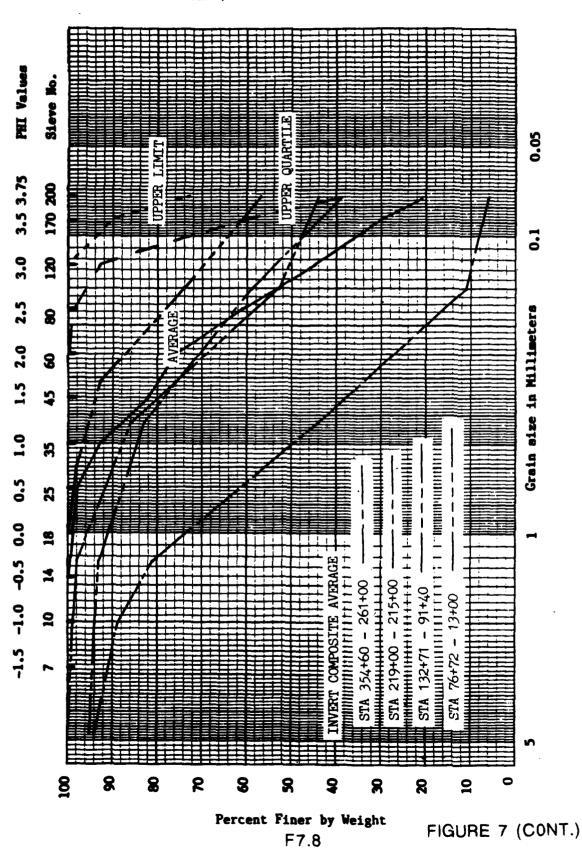
LOWER SANTA ANA RIVER BEACH COMPATIBILITY COMPOSITE BEACH GRADATIONS

STA 477+12 - 750+94



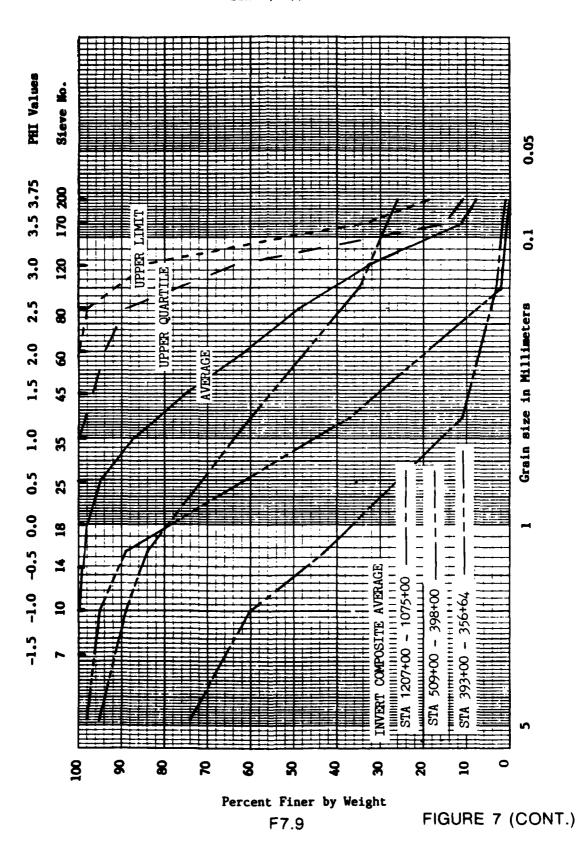
Lower Santa Ana River Beach Compatibility Composite Beach Gradations

STA 477+12 - 750+94

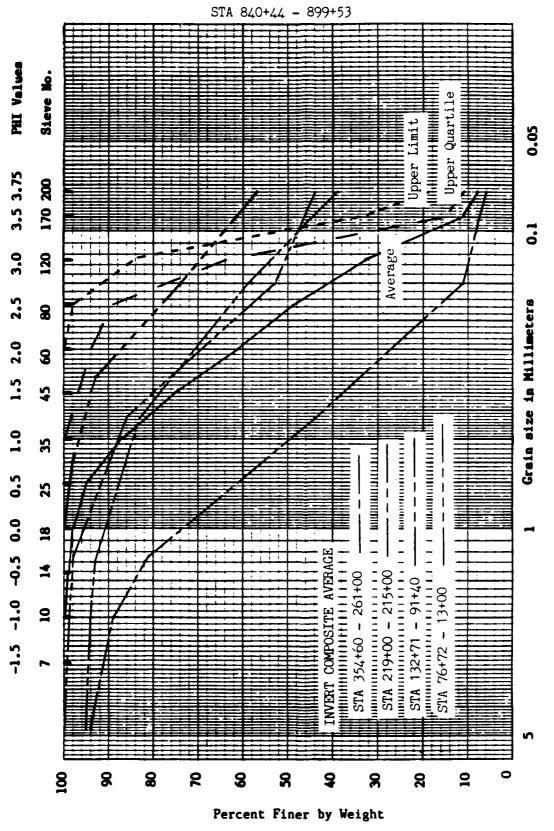


LOWER SANTA ANA RIVER BEACH COMPATIBILITY COMPOSITE BEACH GRADATIONS

STA 840+44 - 899+53



Lower Santa Ana River
Beach Compatibility
Composite Beach Gradations

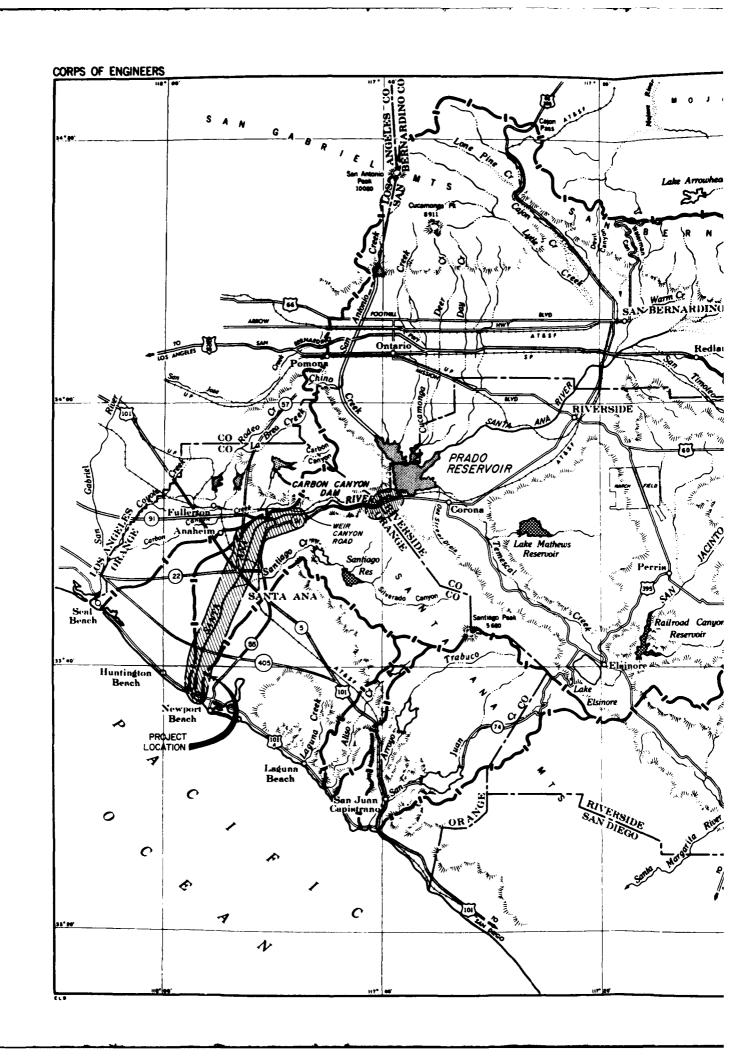


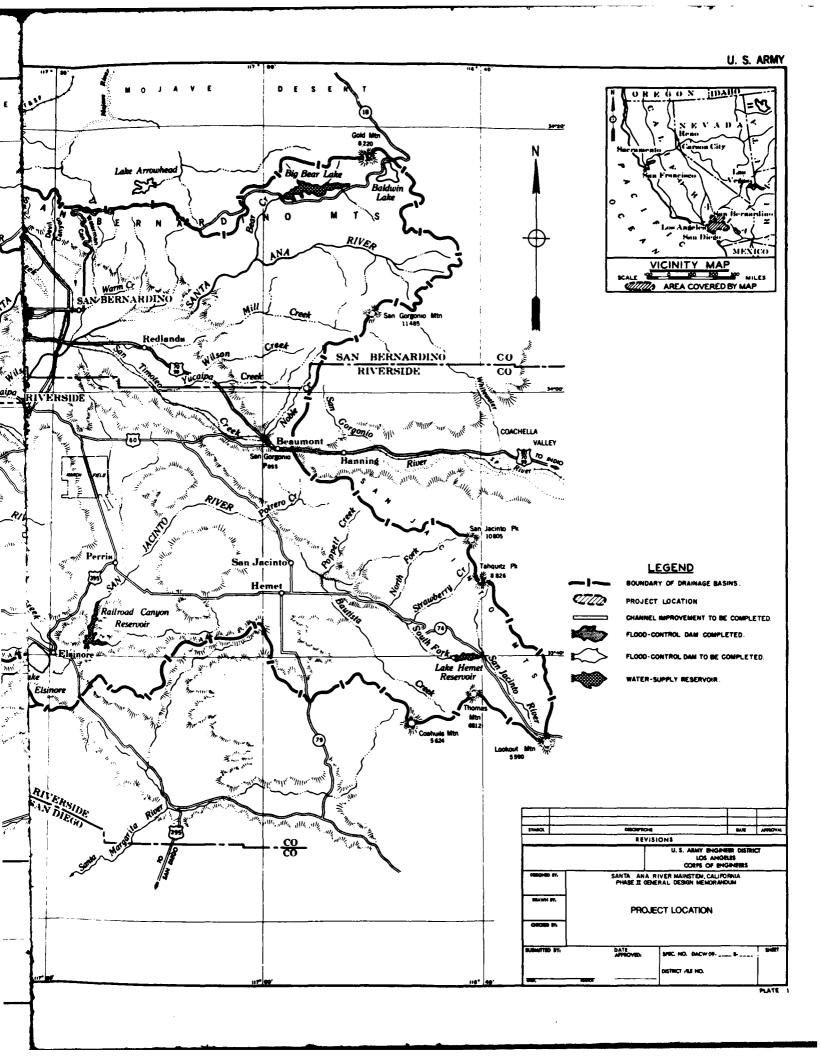
F7.10

FIGURE 7 (CONT.)

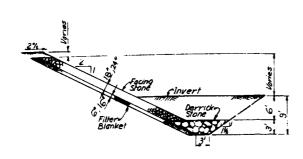
A GEOTECHNICAL

PLATES

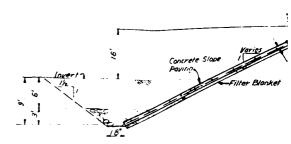




VALUE ENGINEERIN



WEIR CANYON ROAD TO KATELLA AVENUE

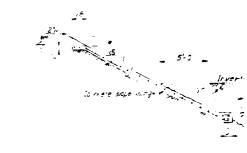


KATELLA AVENUE TO GARDEN GROVE FREEWAY

STA 702 TO STA 697
NOT TO SCALE

LIMITED EXISTING IMPROVEMENT

- . PIPE AND WIRE FENCING.
- . TURF STABILIZED EMBANKMENTS



ADAMS AVENUE TO PACIFIC OC STA. 164 TO STA. 20 NOT TO SCALE

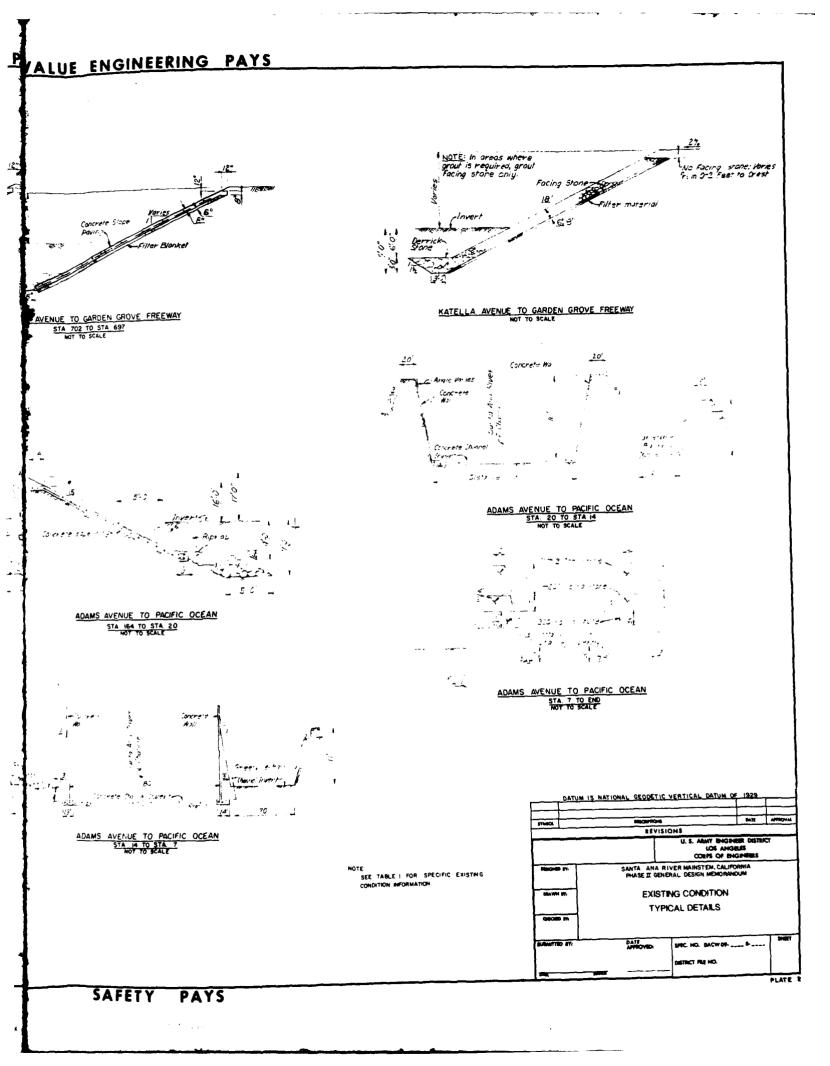
GARDEN GROVE FREEWAY TO 17TH STREET

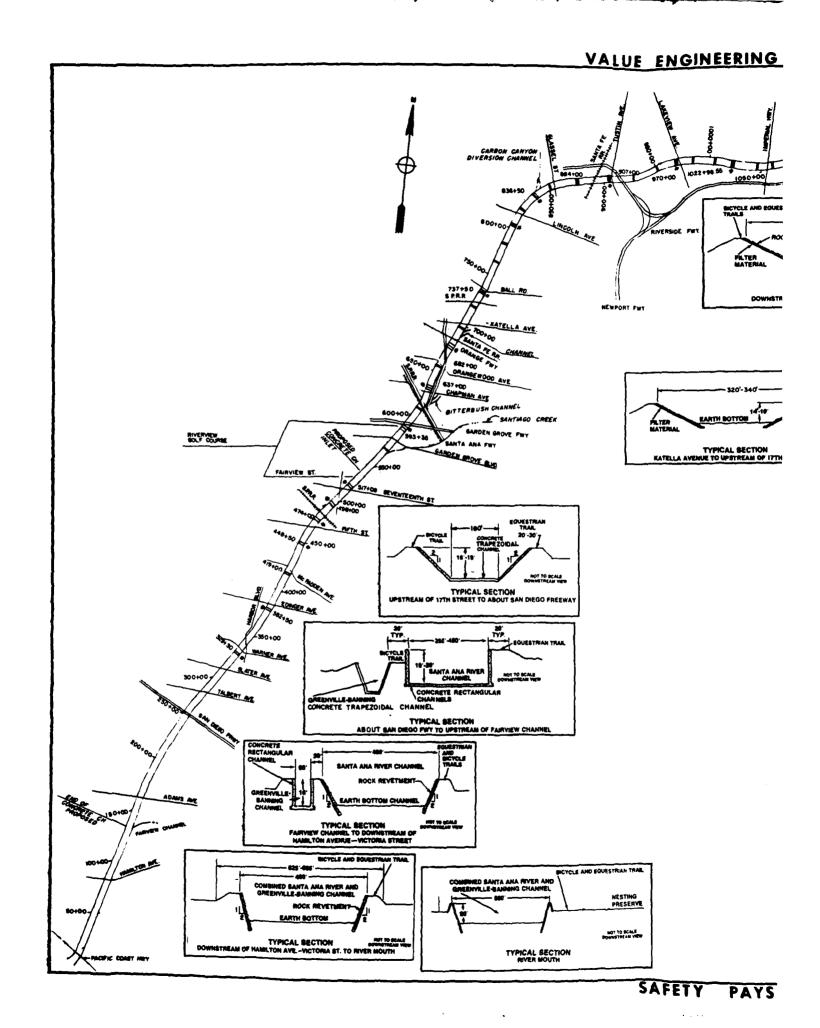


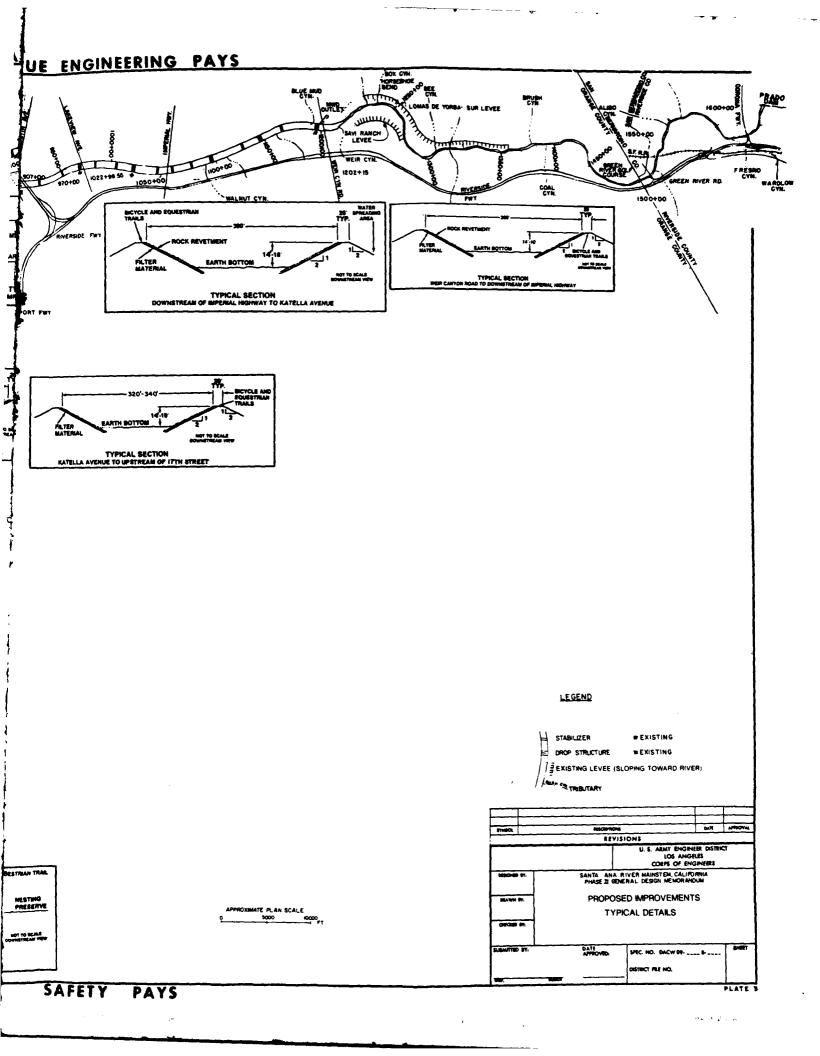
17 IH STREET TO ADAMS AVENUE NOT TO SCALE

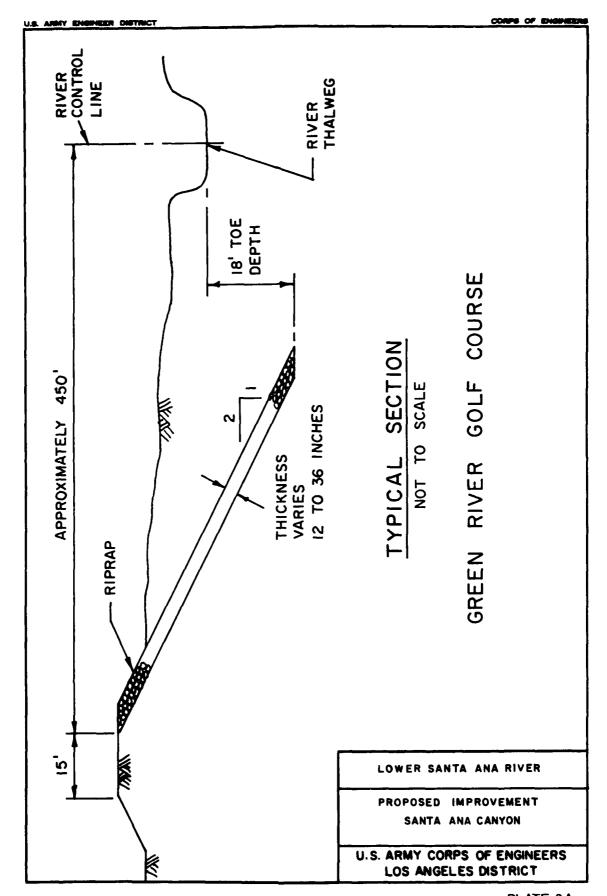


ADAMS AVENUE TO PACIFIC OC







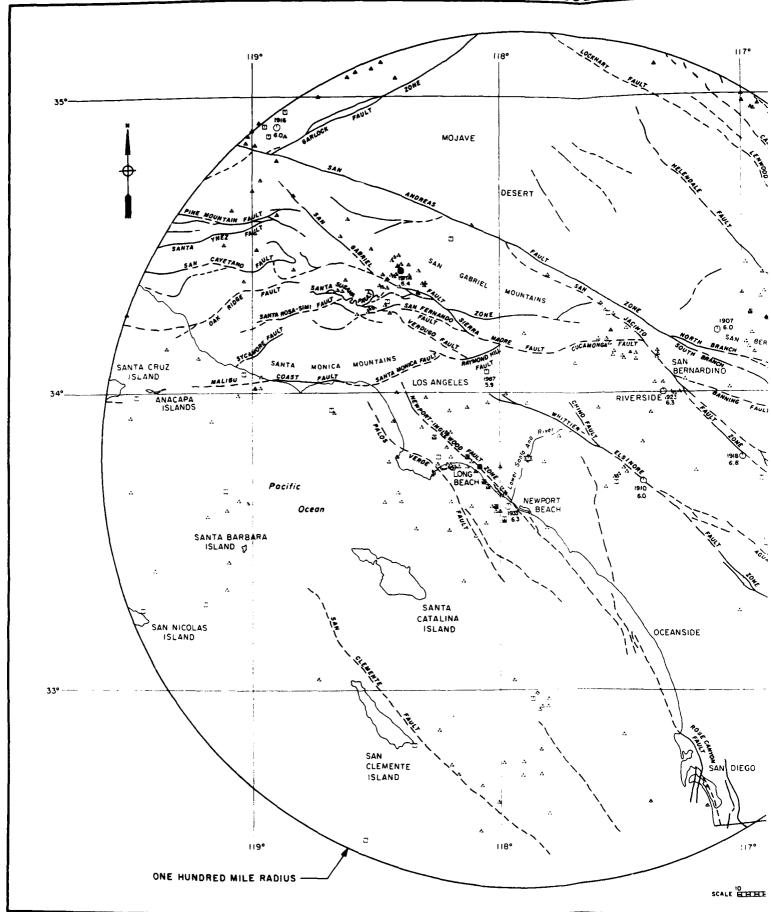


VALUE ENGINEERING & SANTIAGO CREEK GARDEN GROVE TALBERT BARRIER INJECTION INGLEWOOD FAULT PACIFIC OCEAN NEWPORT MESA Epicenter 1933 Long Beach Earthquake

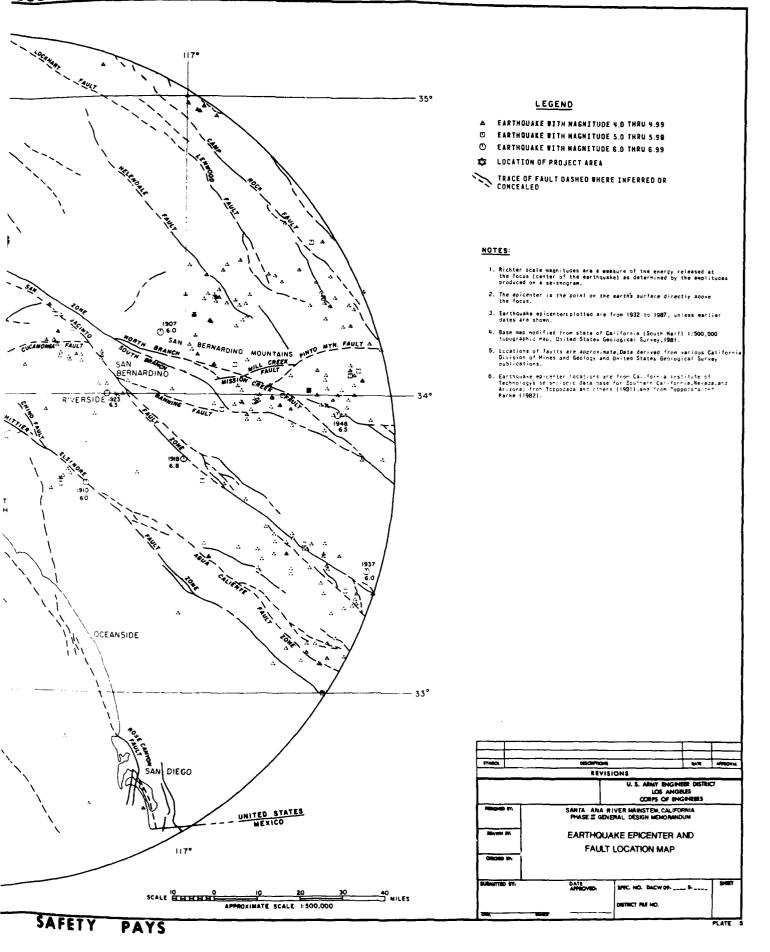
AFETY PAYS

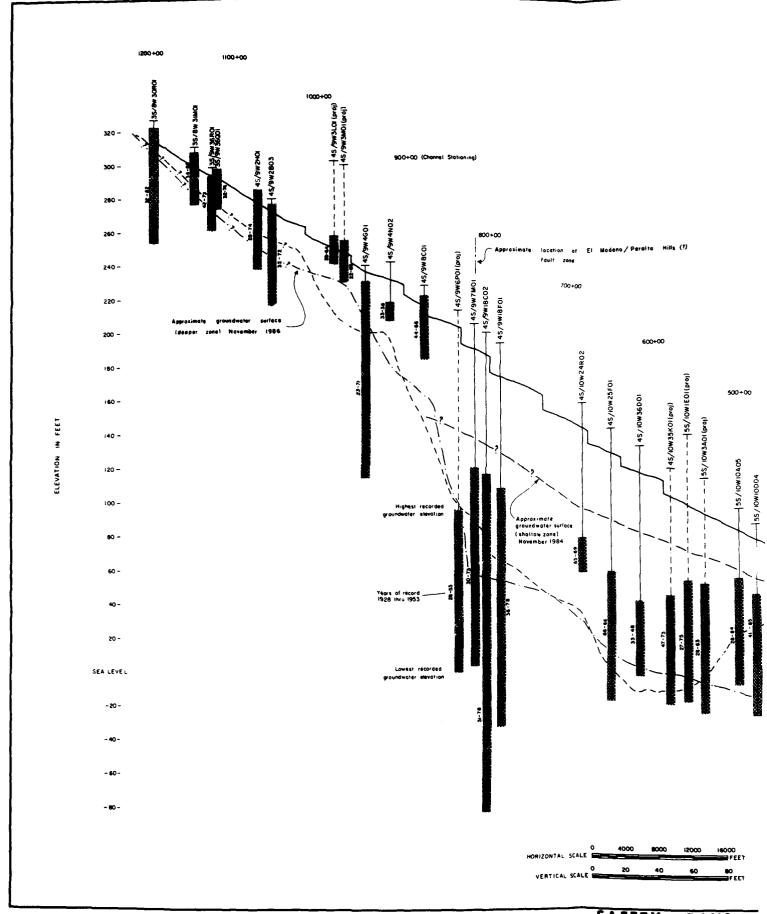
ALUE ENGINEERING PAYS CHINO HILLS PRADO DAM SANTA ANA MOUNTAINS s, 200,00 117*40 - 33°45 LEGEND * *00+00 Tertiory and pre-tertiory formations Pleistocene sediments Recent alluvium Foult, dashed where approximately located, dotted where inferred or concealed Thrust fault NOTES Base map and geology after Mortan and Miller (1981), Schoelhamer and others (1981), and Durham and Yerkes (1964). 2. Location of Peralta Hills Fault from Bryant and Fife (1982). REVISIONS U. S. ARMY BIGDIER DISTRICT LOS ANGELES CORPS OF BIGGINERIS SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM GENERAL SITE GEOLOGY SCALE MILES PLAN SPEC. NO. DACWOF-____ P._ DISTRICT FILE NO. SAFETY PLATE 4 PAYS

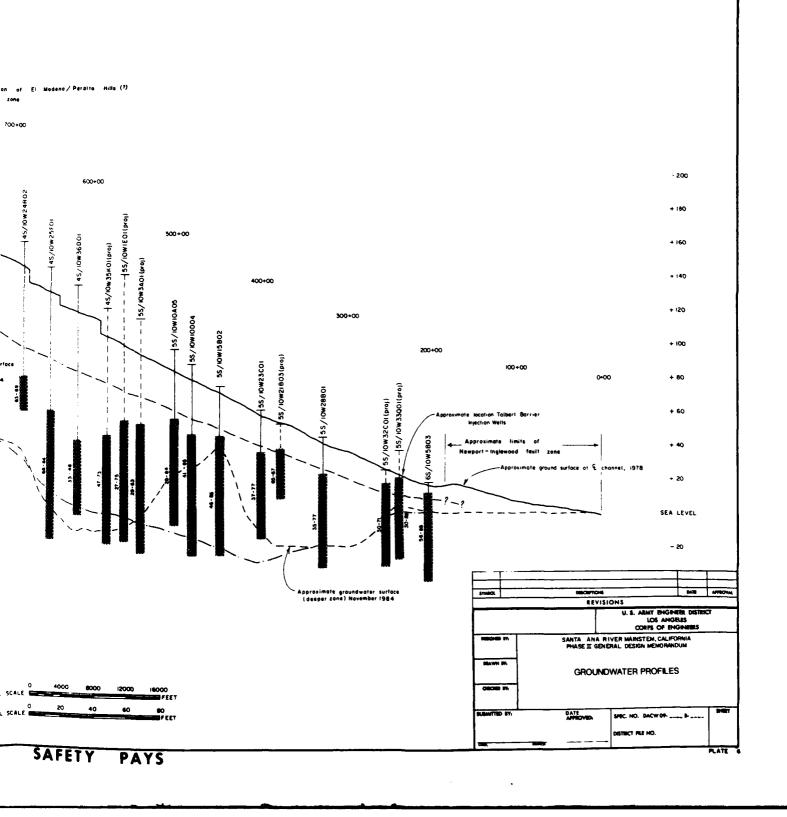
VALUE ENGINEERING PA

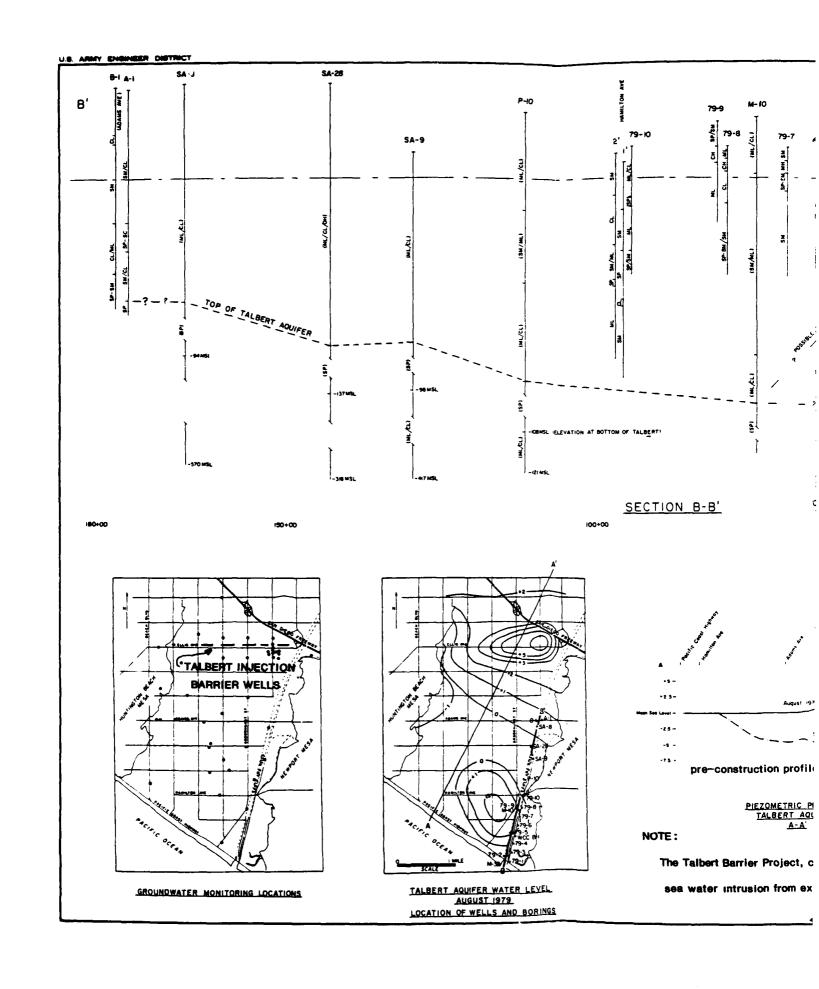


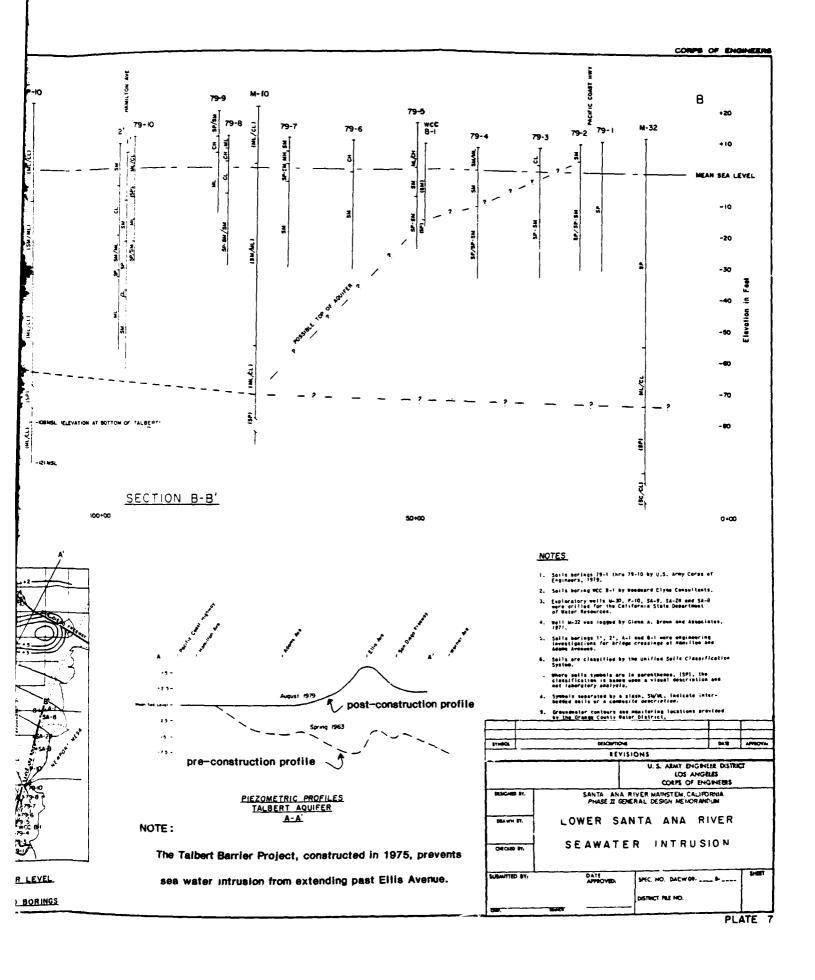
LUE ENGINEERING PAYS



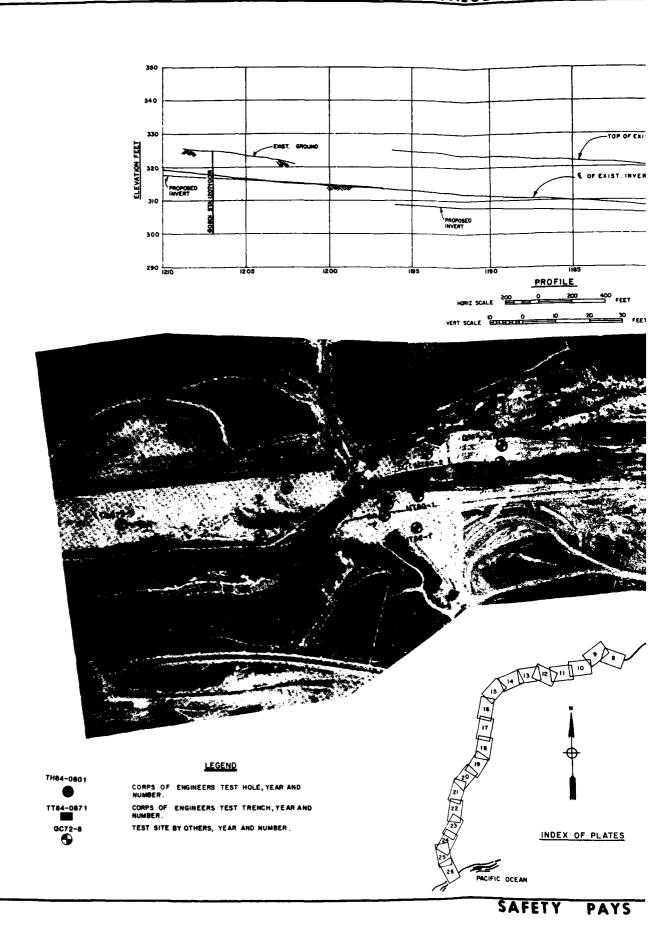


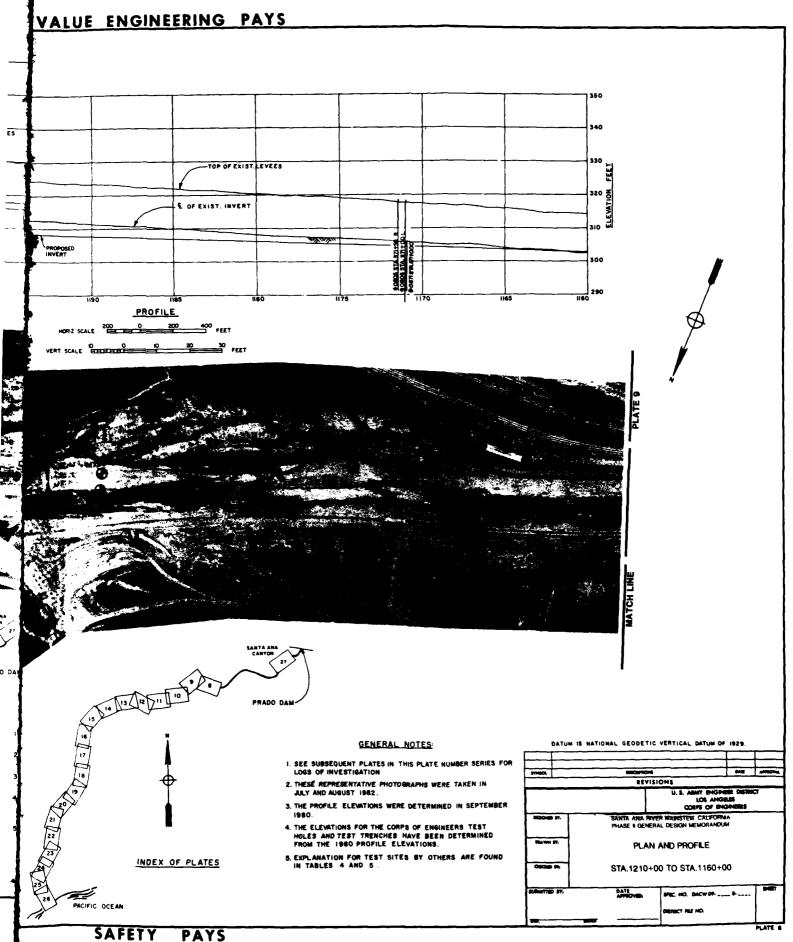






VALUE ENGINEERING F





TH84-0801

THB4-06	1 01		5	TA 120	7+00 R			EL - 325¢
DEPTH	F06	MC	ш	PI	4	-200	н	DESCRIPTION
	99	2			95	3	15	SAID: MHITE, LOOSE TO MEDIUM DENSE, FINE GRAINED SAND-
3.0					70	2	12	GRAVELLY SMID: SAVE AS ABOVE WITH A FBH GRAVEL AND COMBLES TO 5 INCHES.
6.0	99				95	•	11	SAINT: NEDIUM BROWN, LOOSE TO MEDIUM DENSE, OCCASIONAL CLUMPS OF CLIMEY MATERIAL.
9.0	SPI			NP.	99	24	7	SILTY SMIT: MEDIUM DANK BROWN, LOSSE, MEDIUM TO FINE GRAINED SAND.
12-0	SM				73	4	10	GRAVELLY SAMD. MEDIUM BROWN, MILITOLOMED, LOOSE TO MEDIUM DENSE, MEDIUM TO COMISE GRAINED SAMD, 10 PERCENT COMMLES TO 6 INCHES.
15.0		40	41	15	99	70		SAMOY SILT: DANK GREY-GREENISH, NEDIUM DENSE, NO GRAVEL. NODERATE PLASTICITY.
	rL.		33	,	100	67		SME: MITH PRECUENT YEINS OF REIGHT BROWN SILTY SAND THROUGHOUT.
21-9			29	6	86	13	7	SILTY SMITH: DANK SREY-SREENISH, HEDIUM DENSE, MOTERATE PLASTICITY.
25.5	SM			₩	74	?1	30	SILTY GRAVELLY SAND: "JANK GREY-ROOM, MULTICOLORED, MEDIUM GRAINED SAND, FEM GRAVEL.

TH84-0805

TH94-05	305		57	A 1171	+50 R			EL. 318‡					
DEPTH	LOG	MC	LI.	Pl	-4	-290	×	DESCRIPTION					
	91			н¢	52	13	30R	SILTY SAMOY GRAVEL: BARK BROWN, MOIST, GRAVEL TO 3", REPUSAL AT 1:0" DUE TO ROCK-					
3.1	9P/SM			۴	90	q	22	SAMB/SILTY SAMD: "MANK BROWN, MOIST, FINE GRAINED SAMD-					
6.0	714/2M			# P	92	5	23	SAPE: VERY MOIST, FINE GRAINED SAND, GRAVEL TO 374".					
.2.2	59/5H			*	91	5	19						
12-0	SW				77	3	9	GRAVELLY SIMID: Diane before, very moist, coarse grained simb, gramel to 3/A indies, for complex to 9 indies, used hub from 15 feet to 37 feet.					
15:0					34	1	15	SARDY GRAVEL: RAMK BROWN, VERY MOTST, COARSE GRAINED SAND, COPPOLES TO 5 INCHES, BOLLDERS TO 14 INCHES.					
	₽P				37	5							
21.0	SW			₩	96	35		SILTY SAPO: DANK GREY, VERY MOIST, FINE SAND-					
21.5	SM/SM			₩	ъ	6		GRAVELLY SMP/STLTY GRAVELLY SMRD: Duex BROWN, VERY POIST COMMSE BRAINED SAND, GRAVEL TO 374 INCHES-					
30.0													

TH84-0806

TH84-01	906		5	TA 117	1+00 L			FL. 3182		
DEPTH	L06	MC	ш	Pį	-4	-200	N	DESCRIPTION		
3-0	SH	6		NP.	73	n		SILTY GRAVELLY SAMD: BANK BROWN, MOIST, LOO- TENSE, SOME COMESSION, GRAVIEL TO 1", COLANSE GI SOME COMBLES.		
6.0	SM/SM	4		ИP	80	9	18	GRAVELLY SAND, SILTY GRAVELLY SAND: NICHOL, GRAVEL TO 1-1/2 INCHES, SOME O		
9.0	SP/SH			*	65	5	31	SAME: GRAVEL TO 7 INCHES, 17 INCH BOULDER A		
12.0	SN/SH	4		₩	78	9	26			
		_	40	,	95	41		SILTY SAND: TROOM, MOIST, FINE GRAIMED SAND CONESTVE:		
			35	10	39	42	9			
	SM	_		æ	95	17		CAME: LIGHT GREY-BROWN, TAMP, DENSE TO VERY COMMITTEN, FINE GRAINED SAND, MOCK AT \$7'.		
				₩P	99	14	3/MP	PERUSAL AT 27-0) FEET OUT TO ROOK		
							٩	REFUSAL AT 24.5 FEET DUE TO ROOK.		
				φ	95	14	2	PERUSAL AT ?7.0 FEET DUE TO ROOK-		
0.0										

TT84-0871

(NVE 1784-38			۲,	a lin	+30 f			€i, 306±		
neptu .	LOG	*	Ü.	P!		-?~	4	°. PTION		
					75	7		SAMT: TAN-BROWN, VERY TIME, LOD		
<u>w</u> 5 <u>0</u>					s.	2		GRAVEULY SAMTI: GREV-BACKN, SOME MOTSTIPE, 5".		
	99				51	_1.		SAPE: SMEY, GRAVEL TO 4 INCHES.		
					32	1		SAMD: SAME, COMMUNES TO 10".		
					9? .	_1				
15:1 <u> </u>					. 58			GRAFELLY SAMD: MAITICOLOMED, SATURATED, C 15" BOLLDER AT 14"		

TH84-0806

1+00 L			EL. 3181
4	-200	,	DESCRIPTION
73	21		SILTY GRAPELLY SAND: DANK BROOM, MOIST, LOOSE TO MEDIUM MENSE, SOME COMESION, GRAPPEL TO [*, COLANSE GRAPMED SAND, SOME COMBLES-
80	9	18	RAYELY SMOD/ SILTY GRAYELLY SMOD: ROOMS, MOIST, COMPSE GRAINED SMOD, GRAVEL TO 1-1/2 INCHES, SOME COMMILES.
55	5	Đ	SHE: GRAVEL TO 2 INCHES, 17 INON BOULDER AT 9 FEET.
78	9	26	
95	41		SILTY SMID. SPINEN, MOIST. FINE GRAINED SAMP, SLIGHTLY CONESIVE.
78	92	9	
95	17		CAME: LIGHT SPEY-BROWN, THEP, DENSE TO VERY DENSE, WELL CHEMTER, FIME DRAINED SAND, ROOK 4T 18".
99	14	370	Pepinsal at 29.7 REET QUE TO MOOK.
		*	REFUSAL AT 74.5 FEET DUE TO ROOK.
95	14	4	Penisal at 27-3 reet due to POOX.

TT84-0871

:1+00 €

-4	-2ne	N TESCRIPTION
źε	,	CAN') 'AN-MACHEL, VERY LITTLE MOISTINE, 1,005E-
30	2	OR WAS IN CAMP, CORY-RACIAN, SOME HOLSTIME, SOME COMMUNES
-51	2	SME GEPY, GRAVEL TO & INCHES
.92	1_	SAM ^{e. S} AME. COBBLES TO [0".
3/_		
	,	GRAFULY SAMD: MULTICOLORED SATURATED, COMBLES TO 10°, 15° BOLLORE AT 14°

FL TOO!

UNIFIED SOIL CLASSIFICATION SYSTEM

	MAJOR DIVISIONS		GROUP SYMBOLS	TYPICAL NAMES
931	- 1111	11	GW	Well-product gravels, gravel-send mistures, little or no fines.
51 1	1	0 1	GP.	Pearly-graded grovels, gravel-send mintures, little or no fines.
8	18 11 1	111	GM	Sitry grovels, grovel-send-site mintures.
31	1 1 1 1 1 1 1 1	2,5	GC	Clayer gravels, gravel-cond-clay mintures.
	3141	111	5 W	Well-graded sands, gravelly sands, little or no fines.
9 1		3 :	SP	Poorly-graded sends, gravelly sends, Sette or no fines.
8111	3 2 8 2 2 4	111	3 M	Silty sands, sand-silt mintures.
- 4	2 3 4 2 3 3 3 3	2	sc	Clayey sands, sand-clay mintures.
, ; 1	1	j	ML	luorganic silts and vary fine sands, rack floor, silty or clayay fine sends, or clayer silts, with elight planticity.
200.00	8	1	CL	learganic clays of low to madium plasticity, gravelly clays, sendy clays, pitry clays.
GAMED ST.	9	5	OL	Organic silts and organic silty clays of low planticity.
	, E	1.	MH	Inorganic sitts, micacoom or distumpeasus fine sandy or sitty soils, plantic sitts.
- 11	"	3.1	CH	Inorganic clays of high planticity.
	<u> </u>	₹	OH	Organic clays of medium to high planticity, organic silts.
	Highly organic soils		71	Past and other highly organic soils.

- 1. Soundary Classification: Soils presessing chara GW-GC, well-graded gravel-sand minture with clay binder.
 - Z. All sieve sizes on this chart are U. S. Standard.
- 2. All since sizes on this chart fee U. S. Szeadow.

 2. The terms "sith" and "clay" are used respectively to distinguish materials exhibiting lower planticity from those with higher planticity, mines no. 200 sieve martiroid is will if the liquid final and planticity index plot below the "A" line on the planticity chart, and is clay if iqued limit and planticity index plot below the "A" line on the chart.

 4. The See Classification System is seased on the American Society for Testing and Materials (ASTM).

 6. (ASTM) D2487 Standard Test Method for Classification of Sells for Engineering Purposes.

 6. (ASTM) D2488 Standard Recommended Practice for Description of Soils (Visual Manual Procedure).

 - 5. This Classification System is applicable to Corps of Engineers Logs Only

LEGEND:

THR4-OBOL TEST HOLE, YEAR AND NUMBER.

TT84-0871 TEST TRENCH, YEAR AND NUMBER

M.C. PHED MOISTURE CONTENT IN PROCEST OF SEY WHISHT.

LIQUID LIMIT.

P 1 PLASTICITY INDEX (LIQUID LIMIT -- PLASTIC LIMIT).

PERCENT OF MATERIAL BY WEIGHT RETAINED ON HO. 4 SIEVE.

PERCENT OF MATERIAL BY WEIGHT PASSING NO. 286 SIEVE. - 200

HUMBER OF BLOWS BY A 140 POUND HAMMER PREE FALLING 30 INCINES REQUISED TO DRIVE A STANDARD OPEN BIND SAMPLER SPOON ONE POOT.

OBSERVED WATER LEVEL

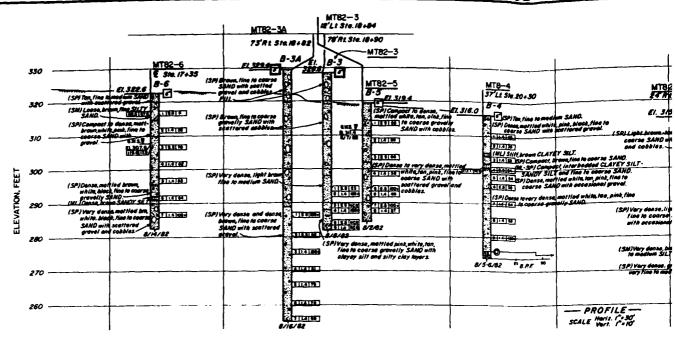
NOTES

- SEE PLATE 8 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- SEE TABLE & FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL OR "EXISTING GROUND" ON BACK SIDE OF THE LEVEE THE ELEVATIONS FOR THE CORPS OF ENGINEERS LOGS HAVE BEEN DETERMINED FROM THE 1980 PROFILE ELEVATIONS (±1 FOOT)
- THE OBSERVED WATER LEVELS INDICATED ON THE LOGS ARE AS RECORED AT THE TIME OF EXPLORATION THESE WATER LEVELS MAY VARY CONSIDERABLY WITH TIME, ACCORDING TO UPSTREAM RELEASES RAINFALL OR OTHER FACTORS



SYMBOL	official controls	D4:	R AFROYAL							
- 	REVISIO		1							
		U. S. ARMY BYGINESS DI LOS ANGELES CORPS OF BYGINES								
DESIGNATIO BAY		SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM								
DEAWN BY.		LOGS OF INVESTIGATIONS CORPS OF ENGINEERS								
STA.1207+00 TO STA.1171+00										
SUBMITED BY:	DATE	SPEC. NO. DACWOR P	314867							

VALUE ENGINEERING

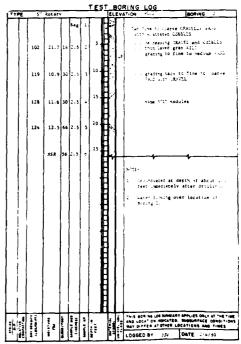


MT60-1

	TEST BORING LOG											
THE	- ;	Recity			-				ATION			BORING 1
		Nás		2.3	1	5.			,	ith 40	attered	CRAVELLY SAND COBBLES ALEL and COSSIE:
	.29	13.+	30	2.5	2	10.	ľ	ŀ	t .		SILT len laver fi	ses ne šilti SANU
	105	25.0	12	2.5	,	15-				•	-	ne to medium SAS
		NSR	28	2.5		20.				5000	SAUTT SI	ET IGNOES
	127	13.0	90	2.5	5	25,						to fine to coarse NEL and L.BBLES
									ega to ap	und-at adiata ar lev and on p of a	assumed ever val ately 200	ch of about 2 fer- dralling saze so elever: n 105 et ct loueret n to et feer south of n e Toned all getteen
100	1, 30. Mar 10.	12	- Contract	1100001	1	e: (1)/	100,00	1	MAY 0	PEATIBL	PRICATES	TO APPLIES ONLY AT THE TOP SUBMERFACE COMPLETOR SCATIONS AND TIMES

Job No. 179-97 - "Arch 12, 1980

MT80-2



Joh No. 179-97 - March 12, 1981

s an area .

VALUE ENGINEERING PAYS MT82-1 8-1 330 Existing ground surface at £ MT8-4 37'LL SN. 20+30 [4] SM) Light From Fine SILTY SAND -FIII.

(SP) Compact, Institled white for pink fine to constant SAND with scattered gravel, cobbies and boulders. MTB2-2A 27 Ny Stazz 41 6 Stazz 320 8.4 8-2A (C SP) The fine to modern SAND.
(SSP) Design motified while pint, block, fine to come as SAND with positioned gravel. 8-2 EI. 314.0

EI. SP) Ton, line to course gravelly SAND. 110118 8.4.5 | F.1 (SP) Dense and very dense motified white, ten.

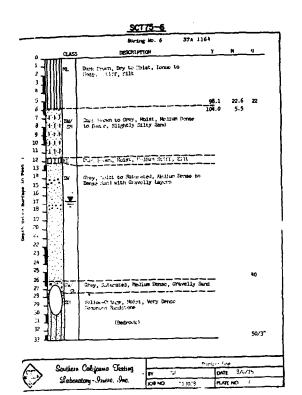
1.310 | S.11.21ma plast fine to corres greenly SAND with scattered cobbies. (SP) Light brown to course SAND and and cobbies. (3)) Compact and dense ten fine to coarse
[1 Ltd [St] growelly SAND with cobbles.
[1 Ltd [St] growelly SAND with cobbles.
[1 Ltd [St] SAND with cobbles.
[2 Ltd [St] SAND with cobbles.
[3 Ltd [St] SAND with cobbles.
[4 SAND SAND with cobbles.] and co

INTEREST OF THE PROPERTY SILT.

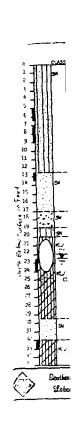
INTEREST OF THE PROPERTY SILT.

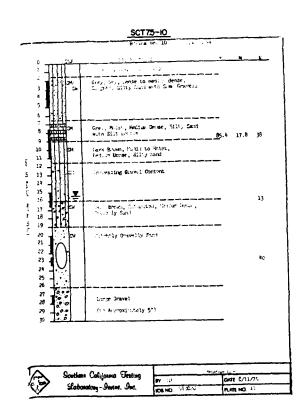
INTEREST OF THE PROPERTY OF THE PROPER 310 (SP) Dense and very dense, mattled white ten (SP) Very dense mettled white, pink block, if a link by coarse gravelly SAND with layers of sitty eley and clayey sitt.

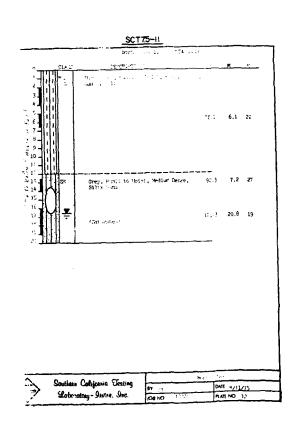
(SP) Very dense mettled white, pink block, fin 111111 course gravelly SAND with cobbles. mea- , 0 11 190 (SP) Very dense, light brown Fine to searse SAND with occasional grown.) Turner 7 | 15 | 1664 | 5 | 15 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 | 1664 | 5 terran P)Vary dense, mottled white, pink, black fine to course SAND with scottered gravet am 3114 909 बानाका plo कारता हा 1 11A 00 0 0 0 10 / 02 BRF W 5-6/82 (SP) Very dease, gray-are muit and कित्रका OI MULTINE गाम छ। 7/30 - 8/2/82 - PROFILE -Shows: SCALE Horiz. 1° 30' 80-2 MT80-3 TEST BORING LOGS ORING LOG BCA NG light gra sorout time to coarse GRAVELL' SAND Tan fine to marke TARLE ... NOTES: 1. SEE PLATE 8 FOR TEST SITE LOCATIONS. SEE TABLES 4 AND 5 FOR LIST OF REPORTS
FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS
AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS ... some Sint function 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE. sorr. Graundwater at leuth in at feet immediately after in . Light gray-brown fine to coarse GRAVELLY SAND water ti wing wer lower a Soring 1 MT80-7 riverbed tight gray-brown fine to coatte /A/ELL THIS GONING USE SUMBARY APS, ES ONLY AT THE AND LIBERTHE HISTORY PROPERTY OF THE AND LIBERTHE LOCATIONS AND THES COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THESE COMMENTS OF THE COMMENT REVISIONS U. S. ARMY ENGINEER DISTRIC MT80-6 LOS ANGELES CORPS OF ENGINEERS 80R##8 6 Liverbec SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM LOGS OF INVESTIGATION BY OTHERS COCCUS IN DATE STA.1220+00 TO STA.1160+00 WANTED BY SHEC. NO. DACWOR. ___ P.__. DISTRICT PLE NO. SAFETY PAYS



	Borring	10.7 STA	172		_
CLASS	DESCRIPTION	s	Y		
5w 5w 1111 1111 1111 1111 1111 1111	Groy to Disk tween, In Redict ferme, 21 dails Gravelly Licens (Cayin, Brice 41)	y to Moist, Lugar / Sifty Susi with	10		
SA/ MI	Dark Block, Plast, to Very Silty Sand	tium Dense,	108.2	14.3	33
5»	Grey to Milto, Skint t Hedium Donze to Dense,	to Suturnited, Sand	109.5	3,0	N2
*			118.8	13.4	51
	Brown-Grey, Caburoled Gravelly Jane	, Mcdium Douse to	Droze,		
Came -	California Testing	T	* 16.5 s	· K	
	ncechicanic Desired	BY S'	DAI	E 8/°/	
		IOS NO 513028		IT NO.	







ALUE ENGINEERING PAYS

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; -[[[]]	Dank Brown, Hum-d to	Motest , Medium Johnson (1)	ity band	1
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79 000	Miller Land Standard Age Miller Land By Land Art Land Land Miller Land By Land Land Land Land Land Land Land Land	film femily to Desse, order	-	
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Scutton	California Testing	· .	*	
	ctory-Isizne. Inc.	\$1	DATE	
<u></u>	ussy-Online, Onc.	108 10	PLATE NO	

NOTES

- 1. SEE PLATE 8 FOR TEST SITE LOCATIONS.
- 2 SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

STRUBOL	MISCHIFTIONS	PATE	APPROVA
	REVISION	NS	
		U. S. AMY INGINEER DISTRI LOS ANGELES CORPS OF INGINEERS	G
Table 11.		ER MAINSTEM, CALIFORNIA AL DESIGN MEMORANDUM	
98AWM 971	LOGS OF	INVESTIGATION	
COCCO M	BY	OTHERS	
	STA.1220+0	0 TO STA.1160+00	
SUBMITTED BY:	DATE APPROVED.	LPEC. NO. DACWOP B	39687
	i	DISTRICT FILE HO.	1

DATE WATER

78.1 £.1 22

163-3 21 5 19

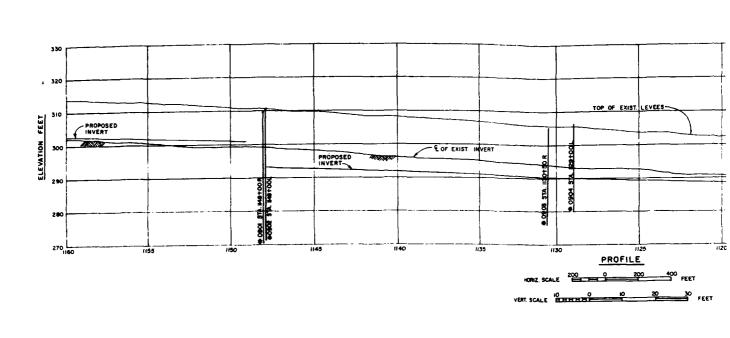
SAFETY PAYS

PLATE SC

GC72-2 GC72-3 GC72-I GEOLABS, INC. GEOLABS.INC. GEOLABS, INC. BORING LOG BORING LOG STATION NO. 1173 + 30 BORING LOS STATION NO. 1171 + 25 STATION NO. 1181 + 40 BURFACE ELEVATION 313.0 ORGEN United States of Control of Contr CL ASSIFICATION (% Send, % Silt, % Clay) (% Sand, % Str. % Cley) (% Sand, % Sill, % Clay) of gravel, dry and loose at the surface, soist and medium dense. an SAND, SP, fime grained at surface grades to course below 1 foot, medium dense, soist, trace of gravel. rades to GRAYKLLY SAND. 123.0 10.5 0 4 122.d 7.0 0 <u>-</u>너이[* 577 7.5 @ h SPT 2 17 SPT (2) kı Thin lense of ORGANIC CLAY, OH, at 10 feet. LOST (3) 3 24 116.0 20.5 3 3 131.0 rades to GRAVELLY SAND, SP, saturated ray ORGANIC CLAY, OH, soft to med-ium stiff, saturated. Thin lense of fine SAND, SP, slightly silty at 19 feet. **€** 81 SPT 11.1 **(4)** Gray ORGANIC CLAY, OH, medium stiff, saturated. ray SAND. SP, with lots of gravel, occasional thin layers of CLAY, OL dense to very dense, saturated. 80(0 133.0 TRY CRAVELLY SAND, SP, saturated. 3] 🕒 🌬 spr Gray CLAYEY FINE SAND, ML. organics, medium danse, saturated. Brown SILTY SAND, SM, dense, -aturat 3 Brown, gravelly SAND, SP, wery dense saturated. Gray coarse SAND, SP, with gravel. Gray SAND SILT. NL. trace of organics medium dense, saturated. (37, 47, 16)
SAMOV SILT
Tab, gravelly SAND, SP, dense, saturated. ⊕ 60 SPT 14.9 ⊕ snt (6) ℸℴℙ℆ Gravelly SAND Dark gray CLAYET FINE SAND, ML, trace of organics, saturated. Tan SAND, SP, coarse grained, trace of gravel, dense, saturated. 0 GC72-8 GC72-7 GC72-6 GEOLABS, INC. GEOLABS.INC. GEOLABS.INC. BORING LOG STATION NO. 1205 + 70 BORING LOG SURFACE ELEVATION J23.5 DROP_20 DHOP 2 O DE LE LO DE LASSIFICATION CL ASSIFICATION CI ASSIFICATION (% Sand , % Siff, % Clay) (% Sand , % Silt, % Clay) (% Sand , % SiH, % Clay) an, gravelly SAND. SP, dry at suct to one foot, moist and medium do below one foot. Tan SILTY SAMD, SM. loose, dry. Fill, tan SAND, SP, coarse, moist, loose. 124. C 25 125.9 ① 9 SPT 14.5 Saturated. 1.0 Tan SAND, 5P, with gravel, medium dense, moist. 3 95.5 17.0 **...**⊡ (... 2 20 Tan gravelly SAMD, SP, very dame, 3 Į. Thin layer of brown SILTY CLAY, CL, soft, wet. (6") SPT 13.0 3 ³² 1 (Hat cob) enses of SILTY SAND, SM, and gray ORGANIC CLAY, OL, saturated. Gray SANDY GRAYEL, GP, dense to ver dense, very difficult to penetra saturated. (4) b 125.5 Gray ORGANIC CLAYEY SILT, OL, BATUTAL SOFT. 31 10.5 4 134.0 5.0 Fan SAND, SF, medium grained, trace o gravel, very dense, wet. 108.5 21.2 45 3 4 3 PT 4.0 3 18.1 Tan, course SAMD, SP, with appreciable amount of gravel, saturated, very dense. Black SILTSTONE, moist hard, with SAND, SAND, SP, Interbed. 6 28 116.d 18. Lawer of STLTY CLAY, CL. stiff (4"). **②** • • 122.5 13.6 - 35 Ø

ALUE ENGINEERING PAYS GC72-4 GC72-5 GC72-3 GEOLABS.INC. GEOLABS.INC. GEOLABS, INC. STATION NO. 1193 + 00 SORMS No. BORING LOG STATION NO. 1199 + 40 BORING LOG 30 No. 1181 + 40 CLASSIFICATION CLASSIFICATION (% Sand, % Sill, % Clay) (% Send, % Sitt, % Clay) (% Sand, % Sill, % Clay) Fill, brown SAND, SP, trace of gravel moist below 3 inches, loose. For SAND, SP, fine grained at surface grades to coarse below 1 foot, medium dense, moist, trace of gravel. Crades to GRAVELLY SAND. 172.0 Ø 0 6 116.0 127.5 ② 17 SPT NO SAMPLE ***** 2 | 1 need SAND, SP, fine grained, clean, medium dense, moist. 10 3 116.0 20 an, gravelly SAND, SP, medium dense, (3) ks 4.2 3 5" 116.5 16.6 Brown SAND, 57, medium dense to dense, Thin lense of fine SAMD, SP, slightly silty at 19 feet. **(4)** @ P3 131.0 5.8 O 3 Brown SILTY SAND, SM, dense, saturate 3 52 SPT 123.0 Rust brown SILTY FINE SAND, ML, mediu dense, saturated. Brown, gravelly SAND, SP, wery dense, 3 h 800 6 36 SPT (b) 48 124.0 13.0 7 8 spt 11.0 7 11 1061 Brown SILTY CLAY, very stiff, soist Gray CLAYEY SANDSTONE, hard, moist 100] @ | 12.2 | 236. GC72-8 Black SILTSTONE, hard, moist GEOLABS, INC. 10H HO. .21% + 15 ACE ELEVATION DROF_ DIRECT SHEAR STRENGTH PARAMETERS CLASSIFICATION (% Sand, % Sill, % Clay) an, gravelly SAND. SP, dry at surface to the foot, moist and medium dense below one foot. NOTES: C 33 125.3 Saturated. I. SEE PLATE 8 FOR TEST SITE LOCATIONS. 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS ○ [* AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS. 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE. Decidat mingrise enses of SILTY SAMD, SH, and gray ORGANIC CLAY, OL, saturated. rsy SAMDY GRAVEL. GP, dense to very dense, very difficult to penetrate saturated. 9" REVISIONS U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM Black SILTSTONE, moist hard, with SAND, SAND, SP, interbed. LOGS OF INVESTIGATION BY OTHERS STA.1220+00 TO STA.1160+00 DATE SPEC NO. DACWOR.___...................... SAFETY PAYS

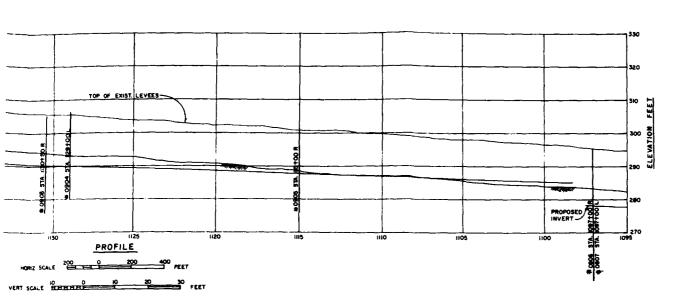
VALUE ENGINEERING PA







ALUE ENGINEERING PAYS







NOTES:

- I. SEE PLATE 8 FOR LEGEND AND GENERAL NOTES.
- 2. SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

			+	+
SMECK	tescurror4		DATE	APPROX
	REVI	SIONS		
		U. S. ARMY EN> LOS ANG CORPS OF EN	eles	ici
basoree av.		RIVER MAINSTEM, CALIF IERAL DESIGN MEMORAN		
CRAWM BY:	PLA	N AND PROFILE		
CHECKE M	STA.1160	+00 TO STA.1095	+00	
SUBMITTED BY:	DATE	SPEC. NO. DACWOP-		3/6
l		DISTRICT PLE NO.		1

SAFETY PAYS

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TH84- 0901

TH 84 -0	901		\$	TA 114	8+00 R			E. 3112			
DEPTH	L06	ΑC	и	PĮ	4	-200		DESCRIPTION			
								GRAPELLY SAND/SILTY GRAPELLY SAND: BROWN, MOIST, FINE TO COMPAS GRAVED SAND, GRAPEL TO 3 INCHES, 5 PERCENT COMPLET TO 6 INCHES.			
	SM/SM	2			67	5					
		2		₩	75	6	38				
5.0	SW	3			81	•	37	GRAVELLY SMITH: MULTICOLORED, HOIST, COURSE GRAINED SMID, GRAVEL TO 3 INDIES.			
) <u>.0</u> _	5P/SP			₩	96	5	22	SAMD/SILTY SAMD: LIGHT BROWN, MOIST, FINE GRAINED SAMD, GRAME, TO 1-1/2 INCHES			
2.0	SV				74		19	GRAVELLY SANT: HULTICOLORED, HOIST, COARSE GRAINED SAND, GRAVEL TO 2 INCHES, STATE COMPLES-			
i.Q	···				97		23	SAND: MALTICOLORED, MOIST, COMPSE GRAINED SAND, GRAVEL TO 2 HOURS, SOME CORBLES, USING MUD AT 13 FEET, MATER AT 13 FEET.			
18-0	58/5N		_	•	55	5	15	GRAVELLY SAND/SILTY GRAVELLY SAND: PULTICOLORED, MOIST, COMPSE GRAINED SAND, GRAVEL TO 2 INCNES, SOME CORRLES-			
.0				_				FRAMELLY SAME: MULTICOLORED, MOIST, COMMSF GRAIMED SAMD, GRAMEL TO ? INCHES, STORE CORRLES-			
	5*			₩P	86	٥	84	SME: REPUSAL AT 25-0" DUE TO COARSE SPANEL-			
.2											
.2	SM		32	5	η	18	v	SILTY FRANKILY SAND: MULTICOLORED, MOIST, COAPSE GRAIMED SAND, GRAEL TO 2 INCHES, SOME CLUMPS OF SILT, DARK GREY, MOIST, COMESINE-			
	52				67	3	21	RRAVELLY SAMD: MULTICOLURED, MOIST, TO MET. COARSE GRAINED SAMD, SOME FINE SILTY SAMD, GRAVEL TO 2 IMCHES, SOME COMMILES.			
.1	SH				"	•	37				
2	çο			····	40	?	34	SAMITY GRAVEL: PALITICOLORED, MOIST, COAPSE GRAINED SAMO, GRAVEL TO 2 INDIPES, REPIREAL AT 35.5 THE TO ROCK.			
.1	ф				52			GRAVELLY SEAM: MILITICOLORED, MOIST, COMPSE GRAINED SAND. GRAVEL TO 7 INCHES.			

TH84 - 0902

T484-0902			_ :	STA LL	#8+00 L			EL- 11±	
DEPTH	L06	MC	Ц.	P)	-4	-200	N	DESCRIPTION	
				_				GRAVELLY SAND/STLTY GRAVELLY SAND: BROWN 3 INDIES, 30 PERCENT COPPLES TO 9 INDIES	
	SM/SR			NP.	60	12			
á.0								SAME: Fine to coarse grained samp grave; some comples, mud used at 6 feet due to	
	-		•				10	GRAVELLY SAND: MULTICOLORED, HOIST, LOO- SAND, GRAVEL TO 2 INCHES, LARGE BOULDER	
	92				79	3			
							11		
2.0							20	GRAVELLY SAND: MULTICOLORED, MOIST, CHARGE TO 3 ICHES, 70 PERCENT MIRELES TO METAL ORAFCE AT 15 FEET AND 15 FEET.	
	Sw				<i>7</i> 9	¥		METAL OBJECT AT 15 FEET AND 13 FEET.	
.0									
	SW/SM			40	38	6		SMM/STLTY SAND: MULTICOLORED, MOTST, C. SAND, SRAVEL TO 3 INCHES, 20 PERCENT TORR	
1-0	SN	-			76	4	11	GRAVELLY SAND: MULTICOLORED MOIST, COAPS GRAVEL TO 3 INCHES, 20 PERCENT CORR.E. C. 5 INCHES.	
-0	94		1¢	1?	95	21	3 2	SILTY SAND: GREEN-BROWN, MOIST, FINE TO SAND, CONESIVE, GRAVEL TO 1 INCH.	
7.3							35	GRANTULY SANT: MALTICOLORST NOTES, 1940 GRANTU TO 1-1/7 INCHES	
	3 2				۳ŋ	1	30	SAME: SMALL POCKETS OF SILTY SAME.	
j. <u>0</u>								GRAVELLY SILTY SWIT: TARK TREY, 411	
	S#		.32_	. 3	95	39_	17	GRAINED SAND, COMESIVE	
:-2				¥	19	15		SILTY SAND: GREEN TO BROWN, MOIST TO WET GRAINED SAND.	
	39				97	•	29	SAND: LIGHT GREEN, MOIST TO WELL FINE SP OCASSIONAL GRAVEL.	
1.9									

TH84 - 0902

•:	-4 	-270	•	THE SCRIPTION
				FRANTLLY SAND/SILTY FRANTLLY SANDL MOME, DRY, GRAVEL T TIMORES, 30 PERCENT COMPLES TO 9 INDRES.
•	4.	17		
				SAME. FINE TO COARSE GRAINED SAMD GRAVEL TO 3 INCHES, SOME CURRLES, MUD USED AT 5 FEET DUE TO CAYING.
-			13	SRAYELY SAND. MULTICOLORED, MOIST, LOOSE, COARSE GRAIN SAND, SRAYEL TO 2 INCHES, LARGE BOULDER AT 17 FEET.
	٠,	:		
			11	
		e == , ,	75	GRANDLY SAMP. MELTICOLORD, MOIST, CHARSE GRAINED SAM GRANDL TO 3 TOMES, 10 PERCENT CHARLES TO 6 INCHES, LARGE METAL DRUPCT AT 15 FEET AND 13 PEET.
	٠.			
Ye	 -32			SWO'X' I'Y SWO. MULTICOLORED, HOIST, CHARSE GRAINEE SWO, SRAYEL TO \$ INCHES, TO REPORT COMPLEX TO S INCHES
	75	•		SAND, GRAVEL TO 5 INCHES, 20 PERCENT CORRUES TO 5 INCHES
	**	•	::	PRIVELLY SAMP. MULTICOLORED MOJSY, COMPSE SRAINED SAMP. SPAREL TO 3 THICKES, 20 PERCENT COMMUNES COMMUNES TO S INCHES.
:	:-	:		CLTY CAN'T: GREDNEROUN, MOIST, FINE TO COMPSE GRAINET SAND, COMESTIE, GRAVEL TO LINCH.
			25	cases, in the trace men, enter, make seather our leading to 110 though
			2.	TAME CHALL SOCKETS OF SILTY SAND.
				PANE + COUTY CANE TANK SHEY, HOUST TO HET, FONE PANES SAME, COMESTION
3_	11	1.	,.	
¥F				THE TY CAN'T GREEK TO SHOWN, MOTOR TO WEET, FINE TO COM LOT TRAINET SAME.
				"W" ISHT TREEN, MITST TO WET, FINE BRAINED SWIT, YEARTONNEL SPANEL.

TH84-0903

TH84-09	303		·	TA 1130)+50 q			FL. 3062		
DEPTH	ſuĸ	MC	u	PI	4	-200	4	PESCRIPTION		
3.0	6M			NP.	50	27	SOR	SILTY SMOY GRAVEL: MEDIUM BROWN, MOIST, GRAVEL REPUSAL AT 1-0 FEET DIE TO VERY BOKSE MATERIAL:		
6.0	الاد. ٢			*	82	8	25	SMB/SILTY SMM: MEDIUM BROWN, MOIST, MEMIUM OBISE, FEI SRAMEL.		
	SW.	5			qq	4	26	GRAVELLY SMITH. SISHET BROWN WITH MALTICOLORED HINERALS, MOIST, MEDIUM DENSE TO LONSE, COMISE SHAIMEN SMITH, SOME SPANEL.		
י נ							11			
15-0	¥	3		чр	90	16	11	SILTY SWID. LIGHT SPONN, DWP "FRISH DENSE TO LONGE. COMPTE GRAINED SWID. LARGE CLIPPS OF DARK SPONN Q.AYS, MATER AT 15 FEET.		
	Sw/5ª			φ	30	5	ą	PANELLY SANTYSILLY GRAVELLY SANT: LISHT BROWN TO SHEY. COMPSE SRAINER SANT, FEW CORRECT, SIME PLASTICITY.		
	7				3n	,	\$	SAYN. "NUTTICOLORED SPAINS "HITS, "NN. YPHIGE , COARSE GRAINED SMO, SPIKE LARSE ROLOGE.		
. <u> </u>	52				*3			SATE: MANY STRANCE, AR CORALES TO STRANGS, MISSER BY DIE TO BROKELY SOUTH APPLICATION OF THE SATISTIC PRINCIPLE OF THE CREATER SOUTH METITICAPPET CRAIMS, MATTER TWO, DRINGS CHARSE TORINGS SAND.		
	S#/5#			r	٠	:	: ,ye	PRAMELY CANDISELED GRAVELY THE RECORDS GREEN CHAPTER SHEW CLIMES TOGETHER IN LARKE CLIMES, GREEN ALL AT 15.0 REC.		
			-	*	:.			SAMP/SELTY SAMP. MAINTOCHORED SPAINS FINE SPAINET CAND DEVISE, MET CLAY LENSES AT 2015 FEET.		
;										

NOTES

- SEE PLATE 9 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE 84 FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- A ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEL CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



SYMBOL	DESCRIPTIONS		DATE	MARON
	REVISI	ONS		
		U. S. ARMY ENG LOS AN CORPS OF E	GELES	d
DESIGNED BY,	SANTA ANA R PHASE II GENE	IVER MAINSTEM, CALI RAL DESIGN MEMORA	IFORNIA ANDUM	
DRAWN SY.	LOGS OF	INVESTIGATIO	NS	
	CORPS	OF ENGINEERS	3	
Gecrap tri	STA.1148+	00 TO STA.113	0+50	
UMMITTE 11	DATE APPROVED:	SPEC. NO. DACWOR-	6	y-est
		DISTRICT PLE NO.		

VALUE ENGINEERIN

TH84-0904

TH64-05	904		S	IA 112	9+00 L			EL. 3062
DEPTH	L06	HC	ш	PI	4	-200		DescriPTION
	SM2C	5	26	5	n	19		SILTY GRAVELLY SAMD/QLAYEY GRAVELLY SAMD: RIGHA, MOIST, LODGE, SOME FINE GRAINED SAMD, SOME COMMLES TO $^{\rm A}$ -1/ $^{\rm A}$ -2.
3.0	SH/SH	3		HP.	100	12	16	SARD/SILTY SARD: Recom, HOIST, SOME COBBLES 4-1/2".
6-0	9P/SM	3		₩.	 79	6	129	GRAVELLY SMAP/SILTY GRAVELLY SMID: COMESE GRAINED SAND, SOME COMMLES TO 5-1/2" MEPUSAL AT 7.0" DUE TO ROCK.
9-0_	SP				90	4	15	SAID: MULTICOLORED, MOIST, FINE TO COMMSE GRAIMED SAME, SOME COMMILES TO δ^2 , MUD ADDED AT 12^\prime DUE TO CAVING.
12.0	5P/SH			нp	99	5	14	SAND/SILTY SAND: LIGHT GREY, MOIST TO MET, FIME GRAIMED SAND.
15-0							. 9	GRAVELLY SAND: MULTICOLORED, MOIST TO MET, FINE TO COMPS GRAINED SAND, SOME CONBLES TO 6".
	٦			₩₽	83	3	7	
21.6								
20.0	SH/SM			₩	76	5	19	GRAVELLY SMID/SILTY GRAVELLY SMID: MULTICOLORED, MOIST TO NET, COMMSE GRAINED SAND, SOME COMBLES-
24.9	50/SP			Ψ	66	6	•	SAME: MULTICOLORED, MOIST TO MET, COARSE GRAINED SAMO, 75 PERCENT COMPLES, 10 PERCENT BOULDERS, LARGE BOULDER AT 26.5'.
25.5								

TH84-0905

T-664-79	905		STA	1115+9	10 R			£1. 301±
DEPTH	FUR	MC	LL	21	-4	-200	k	DESCRIPTION
1.0	SH/SM	-		₩	75	3		PRAMELLY SAMD/SILTY GRAMELLY SAMD: RROWH, MOIST, COAPSE MAINED SAMD, 5 PERCENT COMPLES TO 5 IMPLES.
	92	3			79	?	t8	GRAWELLY SMM): BROWN, MOIST, COAPSE GRAINED SAND. 5 PERCENT COMMILES TO 5 INCHES:
	Ø-124			¥p	36	,	50	SAMP/SILTY SAMD: LIGHT BROWN, MOIST, FINE SPAINED SAMD-
.9.0.	S#		74	ţ	79	4?	n	SILTY SAMP: Dawy gags, Moist, Commissive, Fine GRAIMED SAMD, LARGE CLUMPS.
12.3_							7	SATE: MULTICOLORED, COMPSE GRAINED SAND, SOME FINE GRAINED SAND, GRAMPL TO 1/2 INCHES
	39				_33_		15	SAME: Moist to Het, water at 13 feet, using Muo at 13^{\prime} .
# 18.0	ì							
21.0					51	1		GRAVELLY SAMD: "MULTICOLORED, COARSE GRAINED SAMD, SOME COBALES TO 5 INCHES-
-	9/34			₩	74	3	17	GRAVELLY SAMPLYSTEP ORANGLEY SAMPL. MELTICOLOMBY, MET, COARSE GRAINED SAMD, SYME COMBLES IN \$ INCHES, SOME CLUMP OF DAMY GREY SILTY SAMP, CRESSIVE.
25-5							39	

TH84 - 0906

STA 1097+00 R	0
LL PJ -4 -200 N	De
GRANELLY SAMBA 56 FINE-VEDIUM ON	D/SILTY GRA BRAINED SAME
₩ <i>7</i> 5 9	
29	
SILTY GRAVELLY 31 GRAVED SAND. 8 PRET. 80 74 24	LY SAND: M
GRAVELLY SAND. 32 MEDIUM DENSE, up 57 10 communes to 6	B/SILTY GRA , FINE TO N INDIES, PR
GRAVELLY SAND, 31 SAND, GRAVEL	ID: LIGHT 8
GRAVELLY SART 23 GRAVED SARD, 16-5' DEPTH-	ID: WHITE TO
SAMO: PALTIC 2 Feet Boolds 94 3	(COLORED, C DEPRATIS A
GRANELLY SAM: NP 74 10 COLONED, COM	MT/SILTY GR
SAMOY STATEL 31 MULTICOLORED NP 41 7 OCCASIONAL C	L/SILTY SAM
GRAVELLY SAN 7 COLORED , COV NO. SPT AT 33	WID/SILTY GO DARSE GRAING 13.5 FEET D
w 70 7	
<u> </u>	
SILTY SAND: 21 SAND, COARS CLUMPS THRO	SE CLEAR SA
SAMMY STAVE COLORED. ME NP 31 5 33-40 PERCE	EDITH TO VE

PATALUE ENGINEERING PAYS

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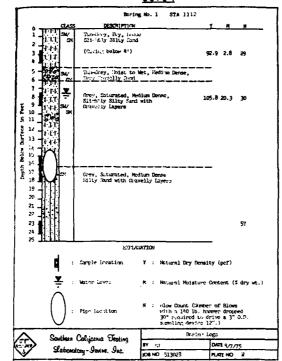
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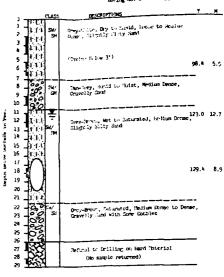
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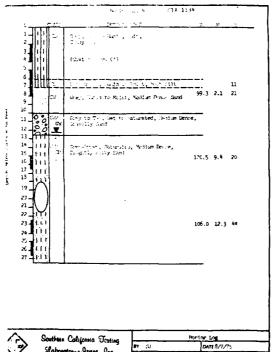


SC75-2 STA 1126 Boring No. 2



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	Southern California Testing	8Y	DATE Q.
	Laboratory-Invine. Inc.	300 NO 111078	PLATE NO

SC75-4



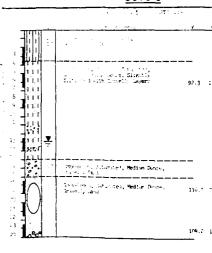
BY SJ

KOR NO

PLATE NO.

Laboratory-Device, Onc.

SC 75-5



€-\	Southern California Testing		the ing top
- 29/	Statementory-Jovine. Inc.	BY 73	DATE
<u>**</u>	Total Control Control	ION NO 11 x3.75	PLATE VE

ALUE ENGINEERING PAYS

		56/5				
		g No. ∠	STA J12		_	
CASS	DESCRIPTIONS			<u> </u>	M	<u> </u>
Sav Sa	Oregon (Jan. Day 1) Dens: (4 mile)	and, lect a vine	to Aculies			
	(CM ≈(A.) = 3,)			98.1	5.5	n
(%) (%)	Deservery, mental to Observe by Cond	nidet, H edi	un Deuse,	_		
<u>∓</u> si⁄	angelone, her to Aligniy belty day	incurated,	Parlium Donne	123.0	12.7	33
				129.4	8.9	36
, S.	Only-Brown, list and Onavoily land with	is, fediam Some double	iknst to D a r	ec,		
	Menical to Emility (No sample re		nerial	_		100+
·	Coliforna Testing		Bor S	ممار] -+ م		
		9v		DAT	3///	
*abom	ntony-Serve, Sec.	108 NO	ranne.	PLA	ENO .	

SC 75-5 92.3 2.9 21 10 in. Medium Dente, To 2008 and a 10 a Medice December 110.7 7.0 19 104.2 15.6 90 Southern California Testing TATE 8/8/75 64 J Laboratory - Green, Proc.

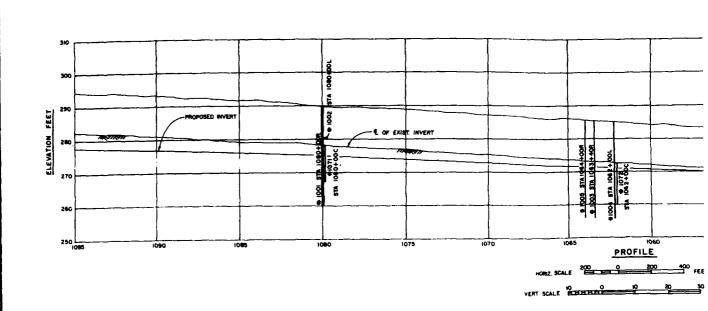
		SC 75-3		
	Burt	ng No. 3	STA 1126	
CLASS	DESCRIP	TION		<u></u>
; 1 991 * 3	Grey-Milte, Bry to dense, Chiently Con	Hamid, lange to Ly Sund	"heli uni	_
1 1 1 1	(Cavin; Relow 5')			
9 0 0 54	Tan-Cray, Handd to Gravelly Sand	Moist, Medium D	ense,	
2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Grey-Trees, Met to Slinkly S. Hty Seed	Saturated, Medi	um Donse,	
15	Grey-Trees, Satural Grave by Fund with	el, Medico Dens Sumo Ocubles	e to Dense,	
·	Sefund to Drilling	on Hard Asteri	al	
		-		
	California Testing	ev	10	ATE BATAS
Schood	ony-Davire, Unc.	IOB NO 513		LATE NO. 4

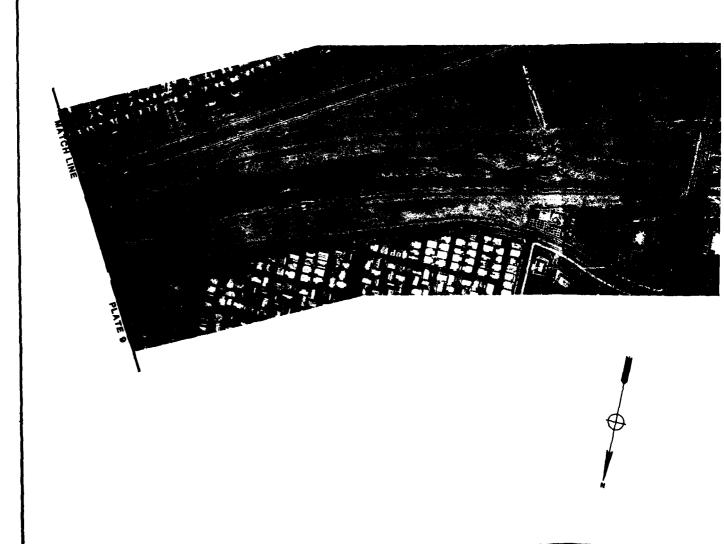
NOTES:

- I. SEE PLATE 9 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE.

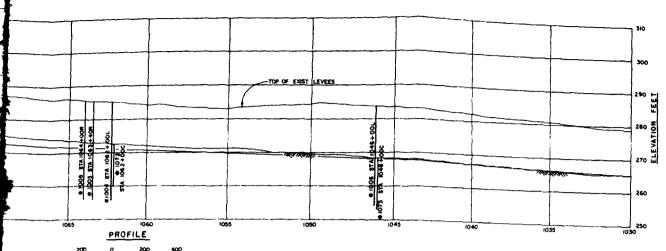
			+	├
SYMPOL	SESCIPTION	1	TRAG	AFFRONA
	REVI	SIONS		
		U. S. ARMY BNG! LOS AND CORPS OF E	BLES	cī
2839Q+GD 37;		RIVER MAINSTEM, CALIF MERAL DESIGN MEMORA		
DBAWN SY.	LOGS	OF INVESTIGATIO	N	
CHICAGO IV.		BY OTHERS		
	STA.1160)+00 TO STA.109	5+00	
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VALUE ENGINEERING



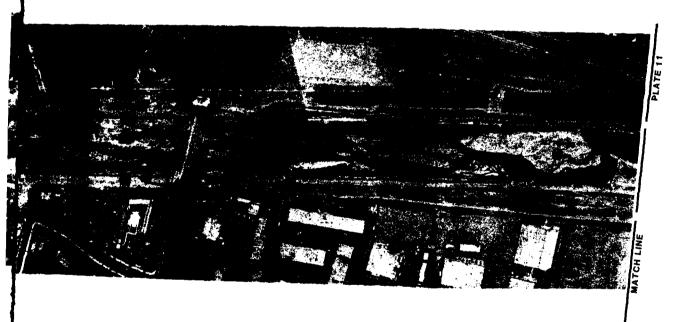


VALUE ENGINEERING PAYS



HOME SCALE 200 0 200 400 FEET

VERT SCALE BEFERENCE 3 30 FEET





NOTES

- I. SEE PLATE 8 FOR LEGEND AND GENERAL NOTES.
- 2. SEE SUBSECUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

					├				
SYMBOL		MICHITONS		DATE	APPROV				
		REVIS	IONS						
			U. S. ARMY ENGINE LOS ANGE CORPS OF ENG	LES	CT .				
DESIGNED BY:	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM								
DEAWN BY.	PLAN AND PROFILE								
08020 3%		STA.1095-	+00 TO STA.1030+	00					
PLANATTED BY:		DATE APPROVED	SPEC. NO. DACWOF		1.5				
			DISTRICT FILE NO.		l				

TH84-1001

T189-1	001		\$	TA 109	0+00 R			EL - 290t
DEPTH	1.06	MC	ш	PI	4	-200	N	DESCRIPTION
								GRANELLY SAND/SILTY GRANELLY SAND: LIGHT MICHER, MOIST, FINE TO MEDIUM GRAINED SAND, GRANEL TO 2 INCHES-
		2		HP.	. л			
								SAME: MEDIUM BAGIN, FINE TO COARSE GRAIMED SAND, FEN CORBLES TO 5 INCHES, NO SPT AT 3.5 PEET DUE TO ROCK.
	SMAN	_		IP.	_ 72			
								SAND/SILTY SAND: SAME AS ABOVE, NO SPT AT 6-5 FEET DUE TO ROCK-
9.0		3		₩	88	8		
							24	GRAVELLY SAND: MULTICOLORED, WHITE, MOIST, FINE TO MEDIUM GRAINED SAND.
	SN	2_			83			
							26	
5-0					79	3		
2:8	sc		36	14	78	44		GRAVELLY CLAYEY SAND: MEDIUM BROWN, MEDIUM DENSE, MEDIUM GRAIMED SAND, SLIGHT TO MODERATE PLASTICITY.
	ÇP				46	3		SANDY GRAVEL: MULTICOLORED SAND GRAINS, COARSE GRAINED SAND, CORRUES TO 8 INCHES, 12" x 8" BOULDER, NO SPI AT 15-5 FEET DUE TO ROCK-
7.0	SW/SM			ИP	77_			GRAVELLY SAND/SILTY GRAVELLY SAND: REDIUM BROWN TO MULTI- COLORED, MEDIUM TO COARSE GRAINED SAND, GRAVEL TO 1", COBBLES TO 9 INCINES, AT 23-5 PEET TO 24 PEET-
				ы			37	
4.0				•	68	9		
	3P			_	56	3		GRAVELLY SAND: MULTICITEDRED, MEDIUM TO COMPSE GRAINED SAND COBBLES TO 4 INCHES, NO SPT AT 24-5 FEET.
6.0								SAMINY SILT: THANK BROWN TO DANK GREY, STIFF, SOME MEDIUM GRAINED SAMO.
	4	29	45	18	93	57	14	
1.5							18	

TT84-1071

INVERT

TT84-10	וע		2	TA 1080	0+00 C			9. 278±
DEPTH	L06	AC	ш	ΡĮ	-4	-200	H	PESCRIPTION
1.0	91		_		65	4		GRAVELLY SAID: BROWN, DAMP, MEDIUM DEN 2 INCHES, OCCASIONAL COMBLES TO 12 INCH GRAINED SAID-
¥4.5		_			л			SAME: BROWN, WE'T, MEDIUM DENSE, FEW CO COARSE SAND, GRAVEL TO 3 INCHES-
	99	_			80_	0_		SAFE: BROWN, SATURATED, LOOSE TO MEDIL COARSE GRAINED SAMD, GRAVEL TO ? INCHES CORRLES, MATTER AT 4-5 FEET.
11.5		_				<u>0</u> 1		SAME: BROWN, SATURATED, MEDIUM DENSE, C COMMLES TO 17 INCHES, CAVING AT 11-5 FE

TH84-1004

TH84-1	104		STA	1062+0	10 L			FL. ?85±
DEPTH	106	۳C	ш	ΡĮ	4	-200	4	DESCRIPTION
	SP	4		*	75	17		SILTY GRAVELLY SAID: LIGHT TO DARK BROWN, MOIST, FINE GRAINED SAID, GRAVEL TO T THORES, SOME COURLES TO 5 THORES.
3.0	SH/SH	2		ΨP	95	5	16	SAMD/SILTY SAMD: LIGHT SAGN, MOIST, FINE TO COARSE GRAINED SAND, GRAVEL TO 1-1/2 INCHES, SOME CORPLES TO 5 INCHES.
6-0	SP/SM			•	75	5		GRAFELLY SAND/SILTY GRAFELLY SAND: LIGHT BROWN, MOIST, FINE TO COARSE GRAIN SAND: GRAFEL TO 1-1/2 INCHES SOME COMMERS TO 8 INCHES, USING MUD AT 1? FEET DUE TO CAVING.
12-0							15	
12-0							?6	SATE: MULTICILORED, MOIST, FINE TO COARSE GRAINED SAND, GRAVEL TO 2-1/2 INCHES, SOME CORBLES.
	SW/SH			*	79	ţ		
13-3							39	
21.0	6P				45	2		SMBY GRAVEL: MULTICOLORED, MOIST, CHARSE GRAINED SAND, GRAVEL TO 2-1/2 INCHES, SOME COMMLES TO 3 INCHES, NO SPT AT 13-5 FEET.
	SM/SM			Ψ	97	10	33	SAND/SILTY SAND: LIGHT BROWN, HOIST, SOME COARSE GRAINED SAND BUT HOSTLY FINE GRAINED SAND, FEN GRAVEL.
24.0	sc			72	95	_ 11_		CLAYY SAME: LIGHT BROWN, MOIST, VERY STIFF TO HAMP, CHARGE TO FIRE GRAINED SAME, COCKSTAND, GRAVEL, FOR CLIPPS OF LIGHT TO DAME GREY SILT: MET, STIFF, CHARSIVE.
30.0			42	20	93	40		

TH84-1003

TH84-100	3		31	a 1063	5+45 P			EL - 2952
95P1R		4(LI.	PĮ	4	-200	4	DESCRIPTION
3.)	Ç.	3			ąp		37	GRAVELLY SAND: LIGHT BROWN, WITH SOM ICLES, MOIST, GRAVEL, FINE TO COARSE
2:4	y			тр 	15	20	ą	STUTY SAND, MEDIUM BROWN TO REACH, MEDIUM SPATHET
9.0							18	
##					73	2	24	GRAVELLY SMID: MULTICOLORED, COMPSE DRAWEL TO 2-1/2 INCHES, FEW CLAYEY CL
							13	
₩,160								SAMP: MEDIUM TO FINE GRAIMED SAMD-
	Ş₽				94	4	50	
		_					> 1	
					91	4	41	SAME: MEDIUM TO COARSE GRAINED SAND-
24:0	 5C		27	3	63	 29		CLAYEY SANDY GRAVEL: MULTICOLORED, C
25.5	SM			VP	89	13		SILTY SAND: MULTICOLORED, COMPLETE COM
27.0	GP.				31	1	27	SAMITY GRAVEL: MULTICOLORED, COMPSE G TO 5 INCHES:
50·0					_			

ALUE ENGINEERING PAYS

TT84-1071

	SI	A 1064)+00 C			A . 2781
r	ш	PI		-200	1	DESCRIPTION
			65			GRAVELLY SAND: TROOM, DAMP, MEDIUM DENSE, GRAVEL TO 3 INCHES, COCASIONAL COMBLES TO 12 INCHES, FINE TO COARSE
				0_		GRALMED SAND- SAME: RICHAN, MET, MEDIUM DEMSE, PEM CORRUES, MEDIUM TO COMESE SAND, GRAVEL TO 3 IMCHES-
_			_60_			SME: RROWN, SATURATED, LOOSE TO MEDIUM DENSE, MEDIUM TO COMPSE GRAINED SMO, GRAVEL TO ? INCRES, GOCASIOMAL COMBLES, MATER AT 4-5 FEET
•			.,	1		
·-			69	l I		SAME: BROWN, SATURATED, MEDIUM DENSE, COARSE GRAINED SAME CORDLES TO 17 INCHES, CAVING AT 11-5 FEET-

TH84-1003

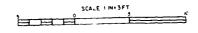
	SŤ	A 1063	4 3 2			£1 - 295‡
•(U.) i	7	-200	٩	TESCRIPTION
ţ			si.		ŧγ	PAST 1497 GIGHT SHOW, WITH SOME MULTICOLOGIC PARTY (CC), THIST, TRAVEL, FIME IT COMES TRAINED SHOW
		p	25	77	1	C. Tr. THY HENT M. BECOM TO MEACH, MOTEST, LOCKE TO MEDITION THE PROPERTY OF A ASSESSED TO MEDITION OF A MEDIT
					:1	
					34	TAKE F (MIT MUTICOLINED, COMPSE GRAINED SAND, FFM JAMES F TO TO TWINES, FRM CLAYER CLIMPS.
			73	2		
					15	
						TANT MEDIT HE TO FENE SPAINED SAND
			Э	4		
					20	
			91	•	41	SAFE MEDIUM TO COMPSE SRAIMED SAMON
	27	3	63	29		CLAYER SHIPT GRAFT! MAITICILOPED, COAPSE GRAINFD, SOME
		₩	69	15		SILTY SMIT. MALTICOLOMED. COMPSE GRAINED SAND, GRAVEL TO 2-17, INCHES.
			Ŋ	1	27	CARRY GRAVEL. MAITICOLORED, COMPSE GRAINED SAND, COMBLES TO 5 INDIES.

TH84-1002

THB4-1(902		\$1	4 1080	₩66 L			FL. 290±
DEPTH	Line	MC	u.	ri	4	-200	*	DESCRIPTION
3.0	SW/SN			Ψ	89	6		SME/SILTY SAID: LIGHT BROWN, MOIST, LOSSE, COMPSE TO FINE GRAINED SAID, GRAVEL TO 1-1/2 INCHES.
		_					10	SAFE: FINE GRAINED SAID, FEN GRAVEL TO 1 INDIES-
		2		10	97	,		
	SP/SM						28	
12.0				₩2	80	,		FRAMELLY SAMD/SILTY FRAMELLY SAME: SAME, FINE TO COMPSE GRAINED SAMD, GRAMEL TO "INCHES, SOME COMPLEX TO 5".
							19	SMID/SILTY SMID: TARK BROWN, HOLST TO MET. COMPRE GRAINE SMID, GRAVEL TO 2-1/2 INCHES, BESAN INSINS MUD AT 15 FEET DUT TO CAMING.
	2M/ <b< td=""><td></td><td></td><td>Ψ</td><td>86</td><td>5</td><td></td><td></td></b<>			Ψ	86	5		
18-0							20	
							19	GRAVELLY SIB: DARK BROWN, MOIST TO MET, COARSE GRAINED SAND, GRAVEL TO 2-1/2 INCHES
	50				7	4		
24. 5							4	
<u> 24-D</u>	514		זיק	6	95	ذر	, id	SILTY SMD, "GREY, "ENTITE TRAKE, MEDITAL TO CHARGE GRAINED SMD, CLAYEY CLAYES.
27.0								CAND (C) TV CAND CO.
	20 \2M	_		MP.	95	5	35	SAMD/SILTY SAMD: FREY, DENSE, HEDIT TO COARSE GRAINED SAMD, LARGER CLAYEY CLUMPS.
30.5				90	73	10		PRAYELLY SAND/SILTY SRAYELLY SAND: MULTICOLORED, MOIST, COARSE GRAINED SAND, SOME CLAYEY CLUMPS, GRANEL TO 3/4".

NOTES

- I SEE PLATE 10 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



STHIOL DESCRIPTIONS REVISIONS U.S. ARMY ENGINEER LOS ANGRES	AR DISTRIC	APPROVA
REVISIONS U.S. ARMY ENGINEER E	XSTRK	
	XSTRK	-
CORPS OF ENGINE	ers	,1
SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM		
BRAWN BY. LOGS OF INVESTIGATONS		
CORPS OF ENGINEERS		
STA.1080+00 TO STA.1062+00	,	
SUBMITTED BY: DATE APPROVED: SPEC. NO. DACW 09 B-		SHEET
DISTRICT PILE NO		

VALUE ENGINEERING P

TH84-1005

INVE	ERT							<u>64 1072</u>			
T184-10) 7 2		ST	ra 106	2+00 C		£L. 2772				
DEPTH	L06	MC	ш	Pl	4	-200	N	DESCRIPTION			
					90	1		SAMD: LIGHT BROWN, DRY, MEDIUM TO COMPSE GRAINED SAND, LOOSE-			
M5 -0					78	0		GRAVELLY SAMD: MIROWH, DAMP, MEDIUM DERISE TO DENSE-			
	3 P				74	0		SAPE: SATURATED, 10 PERCENT CORRLES TO 6", MATER AT 5.0".			
					76	0		SAME: MEDIUM TO COMPSE GRAINED SAMO, 10 MEMCENT COMMLES AT 12 HOGES, BOULTERS AT 13 FEET, POSSIBLE TOE STORES.			
13.0					77						

TH84-1006

736		57	1946	5+00 C			Ft. 2942
F 0/6	MC.	Li	PJ	-4	-?90	*	JESCHIPTION
50		35	!1	94	5.		CLAYEY SAMD, ROOM, MOIST, LODGE, FOR GRAVEL, FINE GRAINED SAME.
SH/S#	3		Ψ	ðů	,		SAND/SILTY SAND: BROWN, HOIST, DENSE, GRAVEL TO 3 INCHES RINE GRAINED SAND.
SW/SC	,	23	f	59	15	48	SILTY GRAFILLY SAMPLEASY OF ACTULY SAMPL. LIGHT TO DARK GREY, "GUST, GENES, GRAMEL TO T HOWES, CORRUES TO \$ INCHES PERISAL AT \$1.5 PERI OR TO ROOMS.
						139	SAND: MULTICOLORED, MOIST, FEN GRAVEL, FINE GRAINED SAND.
æ	1			11_		35	GP RYELLY SAMD: SAME AS ADBIVE, SRAYEL TO ? INCHES, SOME COMPALES TO S INCHES.
				71	3		
Sw				59	;	10	SAME: MULTICOLOMED, MOIST, LONSE, COMPSE GRAINED SAME, GRAVEL TO 2 INCHES, 10 PERCENT COBBLES
Þ				52	9	6	SAME: 20 PERCENT COMMLES TO 10 INCHES, NO SPT AT 20.5'.
مۇ√ەر س			No.	55	5		GRAFTLY SAMT/FILTY SPANELLY SAMT: PREYECTLORED, MOIST, COURSE GRAINED SAMD, GRAFEL TO 2 INCHES, COMPLEX TO
CH/SH			10	79	5	য়	
SH				n	4	v 5	GPANELY SMID: MALTICOLONED, MOIST, COMPAR GRANMED SMID, GRANEL TO 2 (MORES, COMPARES TO 10 IMPORES.
	50 SH/Sh SH/Sh SH/Sh SH/Sh SH/Sh Sh 106 NC 50 50 50 50 50 50 50 50 50 50 50 50 50	106 PC 1: 50 35 SM/SR 3 3M/SC 7 23 SM 3 106 MC 1: P3 50 35 11 SM/SM 3 4P 3M/SC 7 23 5 SM 59 79 79/SM 40 GM/SM 10	106 MC 1: P3 -4 50	106 PC 1: PJ -4 -200 50 35 11 94 72 SM/SP 3 P 39 7 DM/SC 7 23 5 59 15 00 1 1 1 3 SM 59 7 79 52 9 CM/SP 40 79 55 SM/SP 40 79 5	106 MC 1: P3 -4 -200 N 50 35 11 94 27 SM/SM 3		

TH 84 -1(005		2	TA 1046	+00 R			EL - 2841
DEPTH	L06	MC	ш	Pţ	4	-200	Ķ	PESCRIPTION
	SW/SM	3		*	97	7		SAND/SILTY SAND: MEDIUM BROWN, MOS MEDIUM GRAINED SAND, FON GRANFL TO 3
3.0							49	SILTY SAMD: DANK GREY, MOIST, DENSE 1-1/2 INCHES, SLIGHT PLASTICITY, REP
	24	2			91			
9-0		5		100	92	15	268	
	α	19	26	16	97	n	379	SANDY CLAY: DARK GREY, MEDIUM BROWN IN ZONES), MOIST, HARD, MODERATE PLA
12.0	SH/SH	5		Ю	97	11	?9	SMM/SILTY SMID: (.IGHT TO MEDIUM BR DENSE, FINE TO MEDIUM GRAINED SAND-
07.S	Ç#			•	98	25	13	SILIY SAMIT: GREY TO BROWN, MEDIUM TO SAMO, MATER AT 17.5 PEET.
18-0	SH/St			ND.	79	,	11	GRAVELLY SAND/SILTY GRAVELLY SAND COLORED, LOOSE, COARSE GRAINED SAND 2 INCHES.
1.0	34		¥C.	9	34	25	9	GRAVELLY SILTY SAND: GREYISH BROWN, LOOKE, MEDIUM TO COARSE GRAINED MIZE
4.3							148	GRAVELLY SHID/SILTY GRAVELLY SAND: MULTICOLORED SAND, DENSE, MEDIUM TO FEN CORRUES, SOME LANGE SILTY CLUMPS
	in sch	_		ND.	81	10_		
				Ψρ.	31	5	36	
0.C								

INV	RT							
T 18 4-19)73		\$1	a 1048	5 + 00 C			EL - 258:
DEPTH	L06	М.		P)	7	-200	4	DESCRIPTION
					68	0		GRAVELLY SAND: "NULTICOLORED, DAY, GRAINED SAND, GRAVEL TO 3 INCHES, 5
6 .3								SAMD: MULTICOLORED, MOIST TO HET, F GRAMEL TO I INCH-
	50				74	1		SRAVELLY SAND: SAME AS ABOVE, 15 PE 8 INCHES, WATER AT 5-0 FEET.
					59	,		SAME: COBBLES TO 10 INCHES-
14-D	٠		i i		99	 63		SARTY SILT: GREV, MIST TO WET, COM

LUE ENGINEERING PAYS

TH84-1005

SŦ	A 10N	+00 R		EL. 284t								
u	PI	1	-200	N	Rescri≠T1QN							
	*	90	,		SAMO/SILTY SAMO: MEDIUM BROOM, MOIST, DONSE, FINE TO HETIUM GRAINED SAMO, FINI GRAINE, TO 3/4 INCHES:							
				49	SILTY SMM: DARK GREY, MOIST, DENSE, FEM GRANDL TO 1-1-2 INDES. SLIGHT PLASTICITY, REPUSAL AT 7-0 PEET-							
	ıφ	91	20_									
	NP	æ	15	269								
25	15	97	n	39	SAIDY Z.AY: DARK GREY, MEDIUM AROMY, (2 DISTINCT COLORS IN ZONES', MOIST, MAND, MEDERATE PLASTICITY.							
	NP	97	11	*4	CHAPTELEY SAMD: LIGHT TO HEDIUM BROWN OR TAN, MEDIUM DENGE, FINE TO MEDIUM GRAINED SAMD.							
	•	98	75	13	CLTS GAVE. GREY TO BROWN, MEDIUM DENSE, FINE GRAINED SAME, MATER AT 17.5 FEET.							
_	MP.	79	•	Į:	THE CONTROLLY GRAVELY SAMP. MEDIUM BROWNHULTI- COLYET LOSSE COARSE GRAINER SAME AND GRAVEL TO 1 14C-65.							
t;	q	3a	.5	à	WESTER SELTY SAND. SREVISH BROWN, MODERATE PLASTICITY COURSE GRAINED MALTICOL/RED SAND-							
				0يد د	SAMELY SWAYSILTY GRAWFILY SAME. RESYISH BROWN SILT, TULTION, OPEN SAMO, DENSE, MEDIUM TO CORREG GRAINED SAMO, SEM TARLES, SOME LARGE SILTY CLUMPS, REPIRAL AT 75.01							
	HP.	31	11_									
				V.								

TT84-1073

51	4 104	FGC (€L. 268±
	01	4	-5.dt	*	DESCRIPTION
		58	2		PARTLY SAME: MULTICOLORED, DWY, LOSE, FINE TO COMPSE PARTY SAME, SPAMEL TO 3 INCHES, 5 PENCENT COMPLES-
					SATE TO LITECOLORED, HOLST TO WET, FINE GRAINED SAND, PRACE TO JUNCH.
		74	1		GRAFILY SAMO. SAME AS AMOVE, \$5 PERCENT COMBLES AT 2 INCHES, HATER AT \$10 FEET.
		50	,		SME TORBLES TO 19 INCHES:
·	·	79			THE SHAPE SHAPE SHAPE SHAPED SHAPED

NOTES

- I SEE PLATE 10 FOR LOCATION OF TEST HOLES AND TEST TRENCHES.
- 2 SEE PLATE 8 A FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTEO AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE

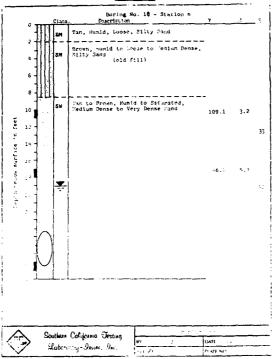


DESCRIPTIONS		DATE	AFFROVA
REVIS	SIONS		
	LOS ANG	ELES	cī
LOGS O	F INVESTIGATION	ıs	
CORP	S OF ENGINEERS		
STA.1062	+00 TO STA.1046	+00	
DATE	SPEC. NO. DACWOP.		SHEET
	DISTRICT PLE NO		
	SANTA ANA PHASE II OP LOGS O CORP STA. 1062	LOS ANG CORRS OF BY SANTA ANA RIVER MAINSTEM, CALIF PHASE II GENERAL DESIGN MEMORIA LOGS OF INVESTIGATION CORPS OF ENGINEERS STA. 1062+00 TO STA. 1046	U. S. ARMY ENGINEER DISTRI LOS ANGELES CORPS OF ENGINEERS SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM LOGS OF INVESTIGATIONS CORPS OF ENGINEERS STA.1062+00 TO STA.1046+00 DATE APPROVED. SPEC. NO. DACW 09

SAFETY PAYS

PLATE IOB

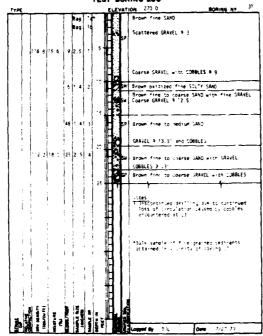
SCT75-18



Soutien Content.

MT70-3I

MARRE & TABER - Conners Gentre or TEST BORING LOG

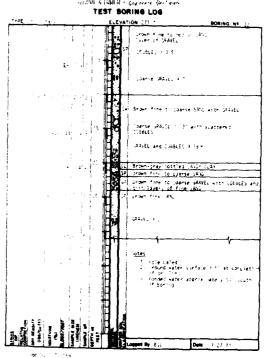




SCT75-19 Boring No 19 111 14 dam, Jeng, Bollman Moral, Value Stiff to Litte, Stapey List. 110.4 15.1 Solve on, and you story long of the composition of 26 Southern California Testina Dob maryaly, w. Jan

MT70-32

Wind DE & TURER . Gag orers for over



MT64-19

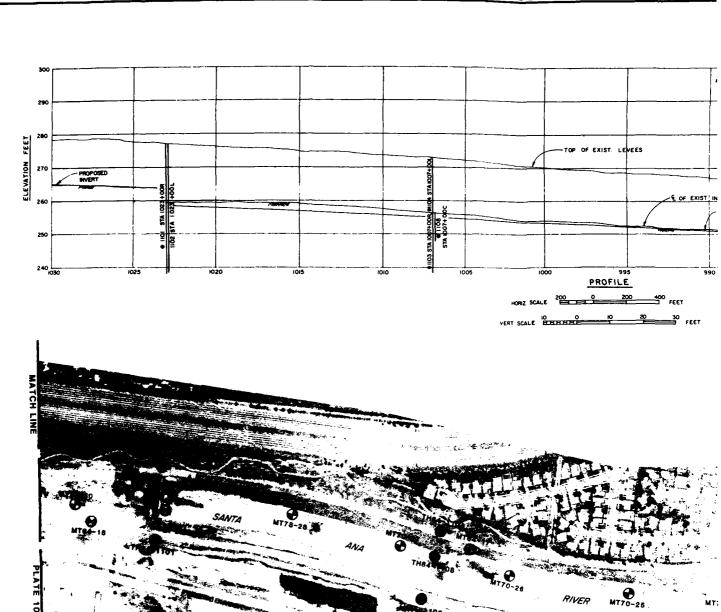
_	F	-	=		-	_	1=	-	-	6.1. 270.71 BORING NO. 10 Elevation 279.46 Completed - 2.17.6.
,	,,		_:			7	ľ			Brown fine to course sand with scattered gravel.
•				Ť	1					
2	70.	+		-	+		20	 - -		Brown fine to course sand with fine gravel, and scattered large gravel.
26 E				+	+		- (+	Brown fine to course sand and fine gravel.
ien it levation)		1	_	ĺ	t	-	-3	1		Intorio ice onekets of From Sand, sandy and silty cirys and blad sandy and silty cirys.
25	, 	+		\vdash	+	-{	ς γ	ŀ.		drown cravelly charge said.
25*	\perp						e ()			Brown fine to course sand with gravel.
•										Boring Incated on tee of slope approx. Act from top of south unprotected benk. Ground water was encountered at elev. 216 in the hole.
										Stagmant unter 350 away at cley. 276. 100 cather flux and was needed. Slight caving show ground sater plus severe caving from 23 to 29 feet. Slow and difficult drilling.
	Dry density		· -	Signal Penetropion (Disastring)	Je 1176	(meher)	Simp + N		Unified state	
	20 00	Mo.St. are	Ċ	1	١٤	ξį	ę.		10.00	

NOTES:

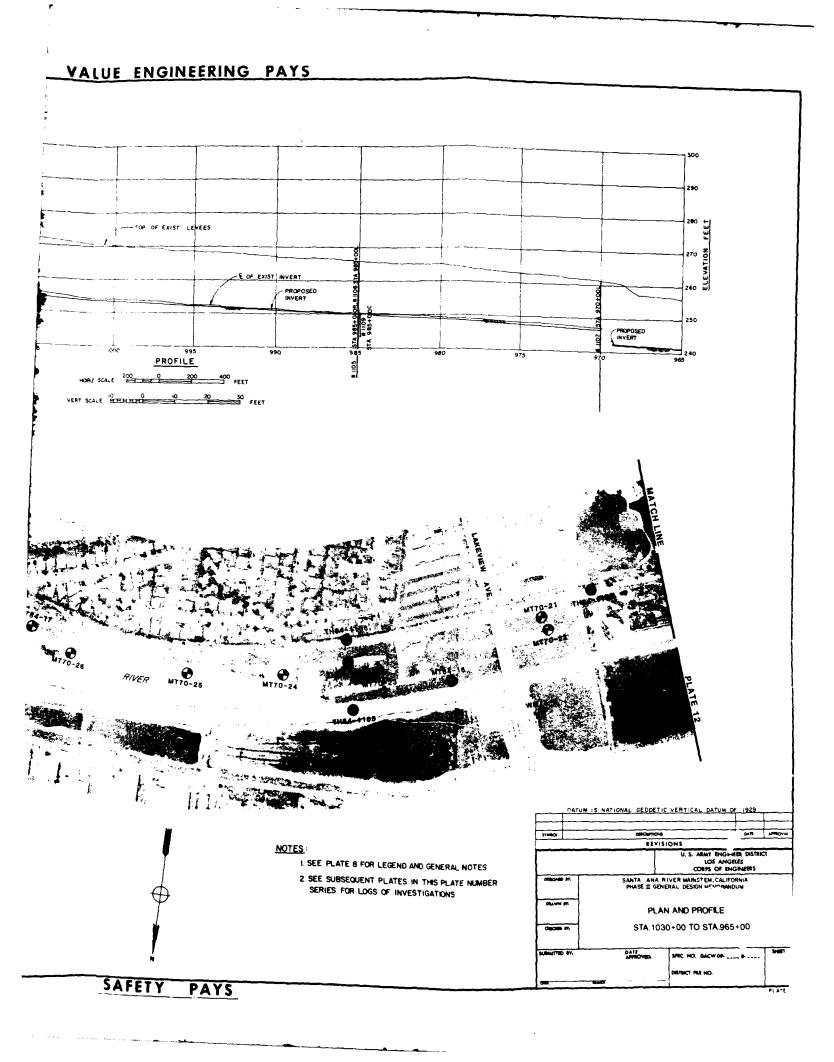
- 1. SEE PLATE TO FOR TEST SITE LOCATIONS.
- 2 SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE.

			 -	├						
SYMBOL	DL DESCRIPTIONS									
	REVIS	IONS								
U. S. ARMY ENGINEER DISTRI LOS ANGELES CORPS OF ENGINEERS										
DESIGNED SY.	OMBO ST. SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM									
DEAWN SY.	LOGS OF INVESTIGATION									
ORGEO ST	BY OTHERS									
}	STA.1095+00 TO STA.1030+									
SUBMITTED BY:	APPROVED.	SPEC. NO. DACWOF	·	SHEET						
58, TE	er ———	DISTRICT PILE NO.								

VALUE ENGINEERING PA







							Ш	84-1101								D	24.35
T1894-1	101		51	A 1023	+00 t			EL · 2772	[1 64- 1	102		STA	1023+0	0 L			
BEPTH	L06	MC	u	Pī	4	-200		DESCRIPTION	BEPTH	L06	PIC	u	۶Į	4	-200	•	
								SILTY SAID: Brook to DARK BROOK, NEDICH TO FIRE GRAINED SAID, SOME CLAMEY CLAMEY, OCCASIONAL GRAVE, TO 1 INCH., 30 BLOSS FOR 5 INCHES PROVIDED FROM 1.0 PREY TO 1.5 PREY	-	SP/GP	1		₩	53	8	-	***
		5		*	90	15			3.0								v1, * v##* *
							22									:*	the story law.
											11_		¥.	90_	_15_		
	54						34	SAFE: DANK GREYISH GREEN, MOIST, FINE GRAINED SAND, SIPE CLAYEY CLUPPS:		54						ť.	34
	3 7	12		₩	94	72					_		r	ĸ	_::_		
							13				12		ø	98	₹;		√200 leas r
									12.0								
							15									5	SMEAN, TAR
14.5								COANCILY CARD. Lawy many and the TITO CORD. MINEY STAFF		39/39	,		₩	97	4		
							158	GRAVELLY SMIP: LIGHT BROWN AND MELTICOLOWED, MOIST, FINE GRAINED SAND, OCCASIONA, GRAVEL AND COMMISS TO 9 INCHES. REPUSAL AT 15 PERT DUT TO A COMMISS.								ĸ	
	So.				53	7			V18.0								
							34			99				92		1.6	and a
121- 0									21.0								
								SAMP/STLTY SAMP. Regy and MILTICOLORED, COARSE GRAIMED SAMD.		34	19	44	;	97	57	•	
	5P/5P			*	97	5			24.0								
	3F13F				•	•	58										380° 20°
27.0										Q.		ν.	s	. 24	55		
27.0							ige agy			_							
** *	SH-5*			•	86	4	χ		To C			37	٠	99	~e		
30-0				•			CR.	SWITH CI.T BROWN TO REDUISH SATHAN, NY GRANEL, VERY SYLFF TY WARD, SOME CONSION:	26:4	۹.		ų.		99	75		2,000,380
	۹.		33	;	39	•			33-0							٦	
	•		**	•		Ī	#E		24:1.	54		75		59	:1	•	7 914. 246.
20.0							•		35.1						· 	. <u>.</u>	
35.5		~		_			27	STETY SAME RANGER TO RETRIES BROWN, MEDITAL DENSE-		92.75				53	;	•	STANS TO ANY STANS TO ANY
10.0	7	ĸ		•			L!		** *						•		AE . 4.9
39.0								CHEN CHANCE Bears on the TIME COST CORD CORD	35-0_							-	

ALUE ENGINEERING PAYS

Ł					<u>T</u>	84-1102
ľ	STA	10234	00 L			£L · 2772
I	u	PI	4	-200	N	DESCRIPTION
		IP	53	8	-	SANDY GRAVEL/SILTY SANDY GRAVEL. THOSEN, MOIST, GRAVEL TO 2-1/2 THORES, FINE GRAINED SAND, FEW COMBLES.
	_				23	$\tau_{\rm LLTY}$ SAMI): Dags brown, moist, gravel to 1-1/2 inches, fine grained samp, some gravel.
Ł		·	_90_	_13		
ľ					37	SAFE: BROWN-
		MP.	<u>æ</u>	15		
			98	31	29	SAME: DANK GREY-
	;				25	SAND/SILTY SAND: LIGHT BROWN, MDIST, SOME CLUMPS OF STIFF SANDY SILT, MATER AT 18 PEET, ADDING MUD AT 18 PEET.
6		₩	97	5		
•					42	
•			22		1é	GRAVELLY SANTY ROOM, MOIST, FINE GRAINED SAND, GRAVEL TO 2-1 7 INCHES, CORRLES TO 5 INCHES.
 •	35	9	97	52	-	SILTY SAMP. REBOISH DAWK BROWN, MOIST, COMESIVE, REPUSAL AT 21.5 FEET DUE TO ROOK.
					,	SARDY Z.MY - REDDISH DARK BROWN, MOIST, CONESIVE-
	29_	3	_3_	_55_		
	32	14	99	58	,	
-	+5	15	99	75	4	CARRY SANTY STOTE: REDDISH DARK BROWN, MOIST, CONESTVE
	n.	*	53	1.4		SILTY TRAVELY SANT. PEDDISH BROWN, MOIST, SOME CONESION, DRAVEL TO S INCHES, COMBLES TO B INCHES.
		ΝP	53	:	ı	SPANELY SAND/SILTY GRAWELLY SAND: MULTICOLINED, MOIST, SPANEL 79 % INCHES, COBMICS TO 9 INCHES, REFUSAL AT 35.0" CIE TO RICK-

Part .

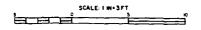
AVE:

TH84-1103

M84-1103				TA 100	/+00 R		EL. 273±			
DEPTH	L06	MC	u	Pi	4	-200	H	DESCRIPTION .		
								GRAPELLY SAND/SILTY GRAVELLY SAND: Brown TO DANK SACH, MOIST, FINE TO MEDIUM GRAINED SAND, FOR GRAVEL TO 1-1/2 INCHES		
	SW/SM	9_		₩.	. 83					
6.0				WP	83	7	24R	SAID/SILTY SAID: SAME AS ABOVE, BLACK STREAKS THROUGHOUS REPUSAL AT 0.0 FEET-		
	SPI	10		HP	93	25	37	SILTY SMID: DANK GREY TO BLACK, MOIST, DENSE, SLIGHT PLASTICITY, FIME TO HEDILPI GRAINLD SAND.		
0.0	SN/SM	5		11	90	6	19R	SAMD/SILITY SAMD: BROWN, MEDIUM TO COMPSE GRAINED SAMD, FEW GRAVEL TO 3/9 INCHES, REPUSAL AT 10:0 FEST.		
2.0								LEN ON WEST 10 314 INCHES, MELOZIE W. TO-0 LEST-		
4.5	29				59	2	21	GRAVELLY SMID: BROWN, DAMP, TOMSE, GRAVEL TO 1-1/2", FI TO MEDIUM GRAIMED SAMD, REFUSAL AT 13-0 FREET-		
8.0	SP/SM	4		Mb.	58	5	44	GRAVELLY SAMO/SILTY GRAVELY SAMO. MEXICOLOMED, MEDIUM TO COMMISE GRAVINED SAMO, GRAVEL TO 7 INCHES, LARGE BROWN, CLAYEY CLUMPS AT 17 PEET.		
					. 83	9_	22	GRAVELLY SAND: MALTICOLORED AND 379MM, MEDIUM TO COARSE GRAINED SAND, GRAVEL TO 7 INDIES.		
	SP							SAND: BROWN AND GREY, DRISE, MEDIUM GRAINED SAND-		
							42			
		_			_89					
5-0					58	3_		SAME: GREY AND MULTICOLORED, DIENSE, FINE TO MEDIUM GRAINED SAND-		
2-9	SM/SM	_		Ψp	85	۲	29R	GRAVELLY SAMPISTICTY GRAVELLY SAND: MULTICOLORED, CONFISE GRAINED SAND, GRAVEL TO 2 INDIES, REFUSAL AT 25-3 FEET.		
7.0							a	SMIN: MATICOLORED, COMPSE GRAINED SAND, SRAVEL TO ? INCHES, REPUSAL AT 27-5 DUE TO POCK-		
	39				91	4		The Lay no traction of the late of the lat		
.5							17			
5-0	99/59	31		φ	95	5		SAND/SILTY SAND: BROWN, MEDIUM TO COMPSE GRAINED SAND, DEMSE-		
5-Q .	SW/S#			₩	94	9	22	SAMB/SILTY SAND: MULTICOLORED, FEW SRAVEL TO I INCH-		

NOTES.

- I. SEE PLATE II FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE 84 FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTEO AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



										
SYMBOL	DESCRIPTIONS	DATE	APPROVAL							
	REVISIONS									
	LOS	NGINEER DISTR ANGELES F BNGINEERS	icī							
SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE IZ GENERAL DESIGN MEMORANDUM										
98AWN 97.	LOGS OF INVESTIGATI	IONS								
	CORPS OF ENGINEER	RS								
COSCORD PIN	STA.1023+00 TO STA.10	007+00								
SUBMITTED BY:	DATE APPROVED. SHEC. NO. DACWO	+ +	\$1400							
	DISTRICT FILE NO.		1							
	·		1							

SAFETY PAYS

PLATE HA

<u>4-1108</u>		NVERT											
£. 2562			•00 C	TH84-1108									
DESCRIPTION	*	-200	4	Pi	ш	ĸ	L96	DEPTH					
GRAVELLY SAND: LIGHT BROWN, LOX SAND, GRAVEL TO 2 INCHES, SOME (OF HOLE-	5	3	56			_	29						
								3.0					
SAMEN GRAVEL: PLATICOLOMED, MO: SAMED, GRAVEL TO 2-1/7 INCHES, SI	17	1	47				5P						
								6.0					
PRANELLY SAND: MULTICOLONED, M COMBLES, NEPUSAL AT 8-5 FEET DU		4	55				8						
	28							8.5					

TH84-II05

MC	ш				त्. 266t			
		P1	4	-2110	*	DESCRIPTION		
t		₩	97	15		SILTY SAID: BROW, DRY TO HOLST, LOOSE TO MEDIUM DENSE, PEDIUM TO COMPLE SRAINED SAND, GRAVE, TO 3 INCHES, FEW CORRLES.		
		¥P	972	8	229	SAMO/SILTY SAMO: Regain, MOIST, MEDIUM TO COMESE GRAINED SAMO, FBW GRAMEL TO 3 INCH, FBM COMMLES, MERUSAL AT 4.0 FEET.		
		*	91	15	42	SILTY SAND: GREENISH BROWN, MOIST, DENSE, MEDIUM TO COMES GRAINED SAND, LENSES OF DANK GREY SILT, COMESTVE-		
			37	2	42	SMID: I JOHT BROWN, HOIST, MEDIUM TO COMPSE GRAINED SAND, FRY COMPLES.		
		MР	17	12	24	GRAVELLY SAND/STILLY FRANKLLY SAND: LIGHT MICHAY, MOIST, MEDIUM DEN Y YUM TO CHORSE GRAINED SAND.		
	54	19	79	34	12	SILTY SAND: DARK GREY, MIST, CREAMIC SMELL, CONESIVE-		
			95	4	^	SAND: GREY TO BROWN, MET, FINE TO MEDIUM GRAINED SAND, WATER AT 18-0 FEET-		
			94	3	21	GRAVELLY SAMD: MULTICOLONED, MEDIUM TO COMPSE GRAIMED SAMD, GRAVEL TO I INCH. ADDED MUD AT 18 FEET-		
	3 0	6	97	M)	7	SILTY SAMD: FARENISH BROWN, FINE TO RETIUM GRAINED SAMD SAML PROCETS OF SILT, NOW COMESION-		
		•	94		26	SAMP: MULTICOLORED, MEDIUM TO COMPSE GRAINED SAND, OCCUSTOMAL GRANG, TO 1 INCH-		
					32			
					15	GRAVELLY SAND: FULTICOLONED, COMMER GRAINED SAND, GRAVEL TO 3 INCHES, FOR COMBLES TO 5 INCHES.		
			69	4				
		54	\$P 54 19	92 37 90 77 54 19 79 95 98 90 6 97	92 25 37 2 39 27 12 54 19 79 34 95 4 94 3 30 6 97 40	92 15 42 37 2 42 37 12 24 54 19 79 34 32 95 4 21 30 6 97 4 7 40 94 4 25		

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INVE	RT							TH84-1109
THB4-11	109		S	A 985+	00 C			FL- 251±
DEPTH	1.06	۳Ç	LL	P!	-4	-200	ų	DESCRIPTION
					79	ą		GRAVELLY SAME: LIGHT BROWN, DRY TO I COARSE GRAVINGS SAME, GRAVEL TO 2 INC START OF HOLE-
	3 P	_						
					72 60	2	16	SAME: MULTICOLORED, MOIST TO MET CO GRAVEL TO 3 INCHES, SOME COMMLES, FA
<u> 1.0</u>								

NOTE:

TH84-1104

	1						ΙH	84-1108
TO #	ł		ST	A 100	7 -00 (£1 - 256±
SIM	1	MC.	ц	Pİ	4	-200) N	DESCRIPTION
·, co	f				66	3	5	SLASLLY SAID: LIGHT BROWN, LODGE, FINE TO REDUM GRAINED SAID. GRAWEL TO Z INCHES, SOME COMMLES, USING MLD AT START OF HOLE.
IT, SI					47	1	- 1º	SHEW SRINEL: "RALTICOLONED, MOIST TO HET, CONRSE GRAINED SHE, GRAVEL TO 2-1/7 INDRES. SOME CHEMILES.
	ŀ	;			55	•	- . 24	RUNCLY SMIT: MALTICOLOMED, MOIST TO MET, STYE LANGE COMBLES, REFUSAL AT 8.5 FERT DIR 171 LANGE BILLITER
	f							
į								
	ŀ							
1								
4	•							
							TH 84	<u>1-1(09</u>
1		TA 98	5+00 C					FL 25[#
) 	LL	Þį	-	-2	700 —	•		"ESCRIPTION
			79		Э		GPAVELL! Charse (Start in	Y SAND. LIGHT BADON, DRY TO MOIST, VERY LOOSE, SPAINED SAND, GRAVEL TO 2 INCHES, USING MUD AT FIGURE.
7			72	_	2	16	SAME II	NE TION ORDER MODER TO ANGEL
-			S)		T -			BLITICOLORED, MOIST TO MET COMPSE GRALMED SAMO, 10 3 IMOMES, SOME COMBLES, FACING STONE AT 7-0 FT.

YHB4-1	104			IA LU	07+00 L			a. 273±		
DEPTH	L06	M.	u	PI	4	-200	1	DESCRIPTION		
3.0	60		372	11	55	13		CLATEY SAMET GRANEL: TAM, DRY TO MOIST, LODGE, MERLA, N TO SAMEQUIDED GRANEL TO \$ THOSES, PINE GRAINED SAME, 5 PERCENT COMMLES TO 4 THOSES.		
6-0	29/SH		_		94	10	21	SAND/SILTY SAND: TAN, HOLST, HEDLUN DENSE, HOLANDED TO SUMPOUNDED OR MANEL.		
9.0	sc		35	12	94	29	28	OLAYY SAMD: BLACK ORGANIC SHELL, HEDILM DENSE, NO CONSTON, COLARSE GRAINED SAMD, HEW MISLEM TO ROUMED DRAMEL TO 3 INCHES.		
	591	28	n	ı	89	υ	ŧΊ	SILTY SMIT: BLACK, OMERHIC SPELL, REDILIA DEPOSE TO DEPOSE OF CONTROL OF THE PROPERTY OF COMPANY OF THE PROPERTY OF THE PROPER		
5. <u>0</u>							230	SAND/SILTY SAND: THE GRAINED SAND, SUB-NASULAR TO ROUNDED OR PREL TO 2-1/2 INDES-		
	SN/SM	_			34	5	29	GRAVELLY SAND/SILTY GRAVELLY SAND: SAME AS ABOVE.		
<u></u>					972	,		NO SPT AT 18.5 PEET DUE TO MOOK.		
1-0	SPI				122	17		SHITY SAND: BROWN-GREY, WET, SOME COMESTON, RIME GRAIN SAND A POCKET OF DAMK, GREY STLT. COMESTOR, MAYER AT 21-0 FRET, ADDED NEVERT.		
.0	r.		49	16	100	64	32	SAMPY SILT: BROWN, MET, MEDIUM DENSE, SOME COMBLES, COMPSE GRALMED SAME.		
.a	SW/SH				59	,		GRAVELY SAMPUTED TO SHAVELY SAMD: "ROOM, COMESE GRAVELY SAMD, ROUNDED TO SHAROLNOED GRAVEL TO 3 INCHES, ROUNDED COMMES TO 5 INCHES, NO SPT AT 24.5 FEET.		
•	SM		30		100	25	16	SILTY SMO. SARYISH BROWN, CONESTIVE CLUMPS, FINE GRAINE SAND, OCCASIONAL ANGLER TO SUBMERLAR GRAFEL TO 2-1/2"		
os	SM/SM	_			31	3	21	SAND/SILTY SAND: LIGHT BROWN, SOME COMESTON, OCCASIONAL ROUNDED TO SUBROUNDED GRAVEL TO 1 THOM-		
	4.		51	6	190	77		SARTY SILT: ROOM, SOME CONESTON, OCCASIONAL ROUNDED SRAYEL TO L INCH., OCCASIONAL COBBLES TO 4 INCHES.		

SCALE: I N-3FT

NOTES

- I SEE PLATE II FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2. SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4. ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

REVISIONS U. S. ARMY ENGINEER DISTRICT LOS ANGELS CORPS OF ROWNERS SANTA ANA RIVER MAINSTEIN, CALIFORNIA PHASE XI CRICKPAL DESIGN MEMORIADUM LOGS OF INVESTIGATIONS CORPS OF ENGINEERS GROWN BY STA. 1007+00 TO STA. 985+00				<u> </u>	-
LOS ANGRES CORPORD OF INCOMESS DIRECTION OF THE CALIFORNIA PHASE IT GENERAL DESIGN MEMORIANDUM LOGS OF INVESTIGATIONS CORPS OF ENGINEERS CHICAGO PH STA.1007+00 TO STA.985+00 LIMINITYD ST. DATE ANGRESIA SPEC. NO. DACW OF	<u></u>		IONS	DAR	MACH
PHASE IT GENERAL DESIGN MEMORANGUAL BRAWN PL LOGS OF INVESTIGATIONS CORPS OF ENGINEERS STA.1007+00 TO STA.985+00 BLAMMITTED SYL DATE APPROVED. SPEC. NO. DACWOP6	·		LOS ANGE	LES	3
CORPS OF ENGINEERS STA.1007+00 TO STA.985+00 RIGHTIND SY: DATE APPROVED. SPEC. NO. DACWOF 6	neto try,	SANTA ANA I PHASE II GEN	TIVER MAINSTEM, CALIFO ERAL DESIGN MEMORAN	PRIA DUM	
STA.1007+00 TO STA.985+00 STA.1007+00 TO STA.985+00 SEMITTED ST. DATE APPECIABL SPEC. NO. DACW 096	WH 97.	LOGS O	F INVESTIGATION	s	
STA.1007+00 TO STA.985+00 DATE ANSONED SPEC NO. DACWOP		CORP	S OF ENGINEERS		
APPEOVED. SPEC. NO. DACWOPS	300 Mg				
APPEONED SPEC NO. DACWOP6			+00 TO STA.985+	00	
DISTRICT FILE NO.	780 GY.		SPEC. NO. DACWOF		2000
			DISTRICT PLE NO.		{
			DISTRICT PILE NO.		

SAFETY PAYS

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ST VER CHA

TH84 - 1106

TH84-13	106		\$1	A 985+	00 L			EL. 2562
DEPTH	L06	MC	u	PI	4	-200		DESCRIPTION
	SH/SH			ИP	90	8		SAID/SILTY SAID: Two, LOOSE TO MEDIUM DENSE, FINE GRAINED SAID, FEN ROUMDED TO SUBMOUNDED GRAVEL, FEN ANGULAR COBBLES TO 4 (MCHES.
3.0_	581	7		₩	98	17	15	SILTY SAND: TAN, MOIST, FINE GRAINED SAND
6-0	SP				92	3	12	SAMD: TAN, MOIST, MEDIUM DENSE, COMPRE GRAINER SAND, FEN ROUNDED BRANKI. 10 1/2 INCN. COLOSTIONAL ANGLIAN TO SIE- MRELLAN COMMILES TO 6 INCN.
9.3	SP/SM	3		P	89	5	18	SMID/SILTY SMID: Two, MOIST, COMPSE GRAIMED SMID, FEM ROUMED GRAVIEL TO 1/2 INCMES, 5 PERCENT MIGULAR TO SUB- MIGULAR CORRULES TO 6 INCMES:
12.0	a	2			77	4	26	GRAVELLY SMID: Twi, MOIST, COMPSE GRAINED SAND, RYLINDED GRAVEL, 5 PERCENT ANGULAR TO SUBMIGULAR COBBLES TO 6 INDRES.
15-0	SH/SM	3		40	86	2	29	SAMD/SILTY SAMD: TAH, MOIST, COARSE GRAINED SAMD, ROUNDED GRAVEL, 5 PERCENT ANGLER, TO SUBMETLAR CHARLES, MATER AT 18-0 FEET.
H13-0	97				38	2	23	SAMD: COARSE GRAINED SAMD, GRAVEL TO 3 INCHES, CORRLES TO 5 INCHES, CAVING AT 18-D FEET.
21.0	SH/SH			NP.	93	7		SAND/SILTY SAND: COARSE GRAINED SAND, MIGHLAP TO SUB- ROUMED GRAVEL TO 3 INCHES, FEW MIGHLAR TO SUBMIRILAR COBBLES TO 3 INCHES.
24-0					61	1	11	GRAVELLY SAID: Tam, MEDIUM DENSE, COARSE GRAINED SAND, MIGULAR TO SUBROUNDED GRAVAL.
	59	-			96	3	14	SAMD: TAM, COAMSE GRAINED SAMD, FINE GRAINED GPAVEL TO 1/7 IMCH, POCCETS OF PROMISES GREEN SILT AT 79.0 FEET, SOME COMESSION
30.0	₫ I			Ю	92	20	7	PRAYELLY SILTY SAMP: TAM, COMPSE GRAINED SAMES, POCYETS OF BROWNISH CREEK SILT.
33.0 35.0	SH/SM			₩P	33	9	7	GRAVELLY CONTINUED GRAVELLY SOUTH: COMPOSE GRALMED SAME, SUBMOUNTED TO AMOULAN GRAVEL TO 2 INC-ES, PROCEETS (QUAPES) OF SILE BINDING SAME TORESTER, SOUTH CONTINUED SAME.

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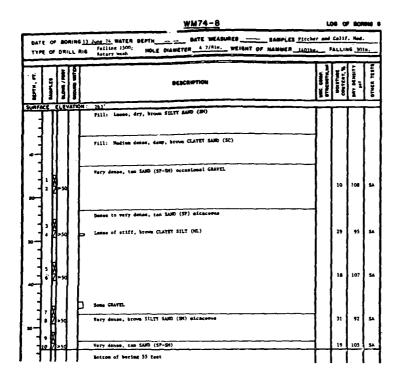
SEE PLATE - POR LOCATION OF TEST HOLES AND TEST TRENDIES

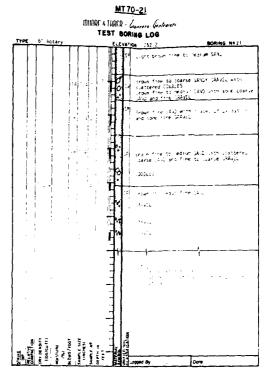
- 2. MEE PLATE BE FOR LEGENG AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 4 TOP CATE OPPLIED OF EXCAVATED ME
- 4 ALL TEST MOLES AND THENDES WERE SET IN TO THE LETE CREST INLESS STHERMINE WOTES AS THURSHY IN THE CHANNEL AND TEX STHER SHOUND ON BACK SING OF LETE.

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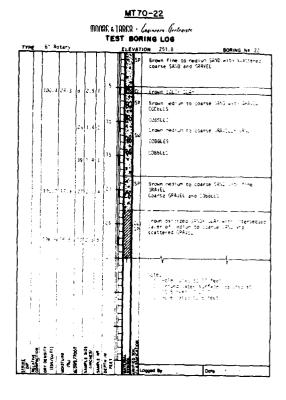
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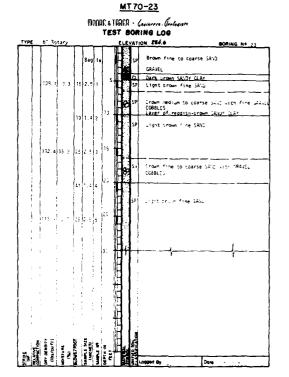
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NOTES:

- I. SEE PLATE II FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

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SAFETY PAYS

PLATE IID

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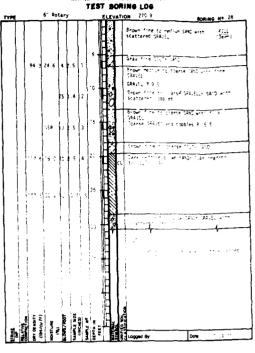
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NOTES:

- I. SEE PLATE II FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

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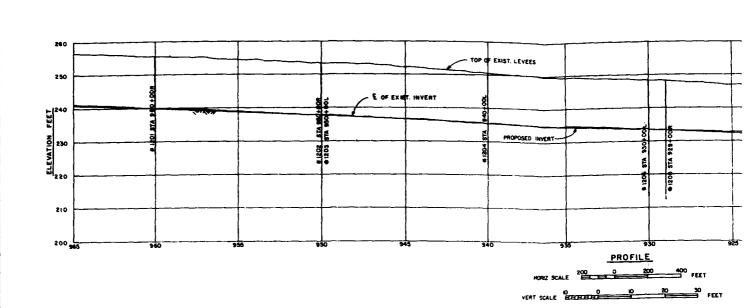
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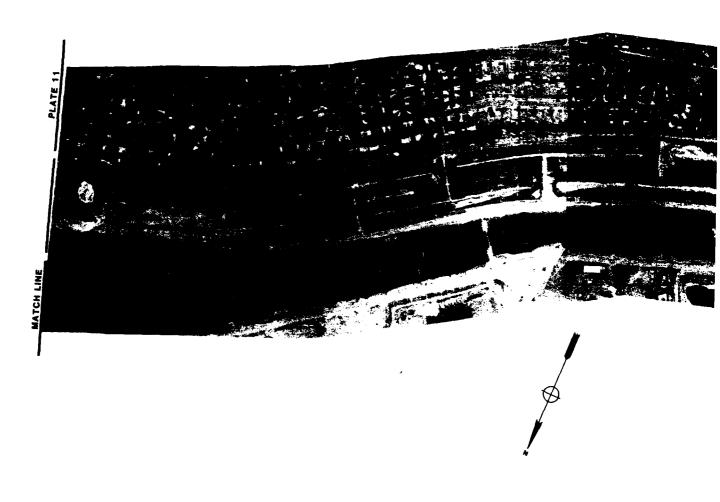
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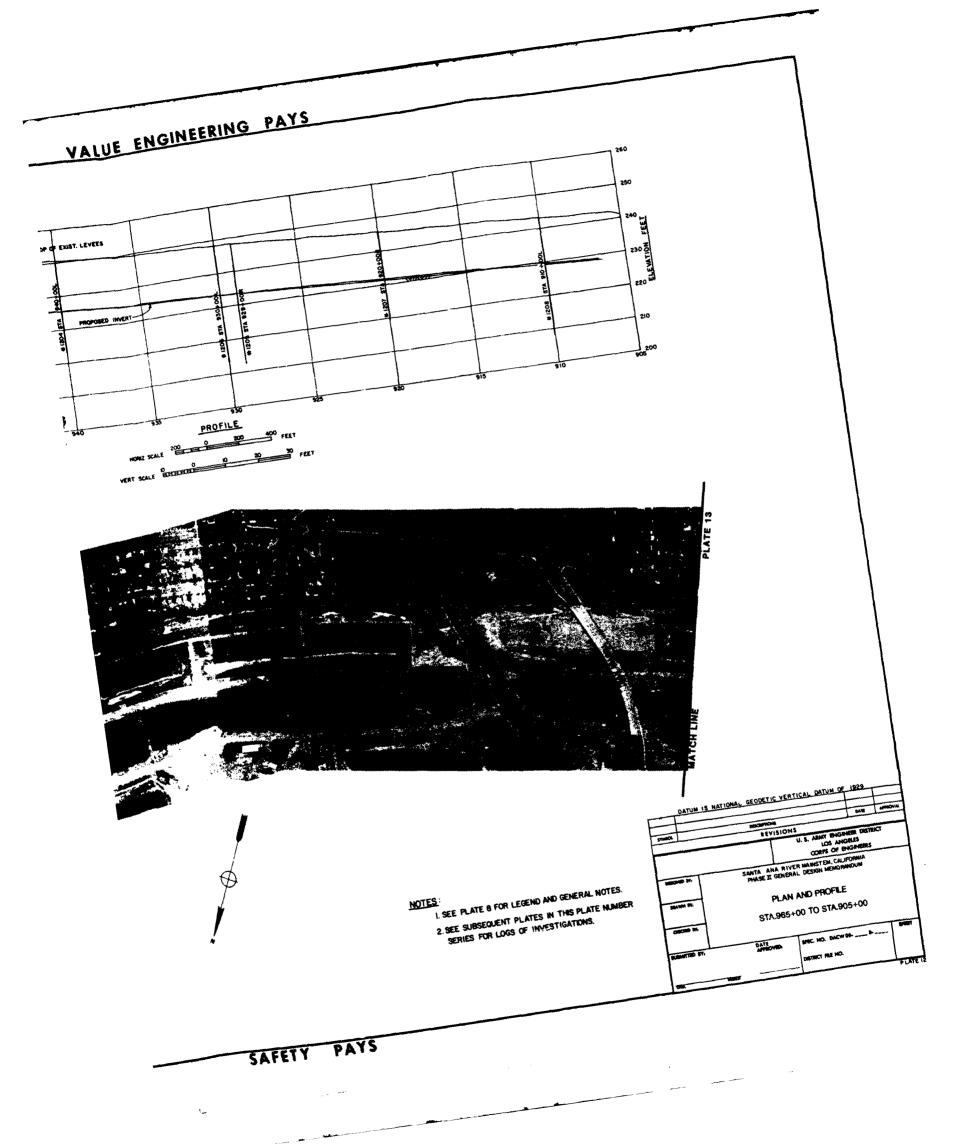
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DEPTH	L06	MC	u	Pl	-4	-200	н	DESCRIPTION
	SM/SP			ИP	90	8		SAID/SILTY SAID: RICHM, LOOSE, FINE GRAINED SAID, FON GRANEL TO 1 INCH-
1-0	SP/SM	_		NP.	94	5	w	SAFE: WITH CLUMPS OF BROWN, MOIST, CONESIVE SILTY SAND, REPUSAL AT 4.0 PRET-
6-0	591	9		₩	98	20	188	SILTY SMID: GREY, MOIST, FINE GRAINED SAND, REPUSAL AT 7.0 FEET.
9-0_	SH/SM	_		NP	92	10		SAND/SILTY SAND: GREY, MOIST, FINE GRAINED SAND, FEW GRANEL TO 1-1/2 INCHES.
12-0							4 0	SILTY SMITH: GREY, MOIST, FINE GRAINED SMID, CLUPPS OF CLUMEY MATERIAL, ADDRED MID AT 18.0 FEET, REPUSAL AT 16.0'.
	54			ЖP	98	33	278	
18-0							•	
¥ 19:5							179	GRAVELLY SAMD/SILTY GRAVELLY SAMD: MULTICOLORED, SATU- RATED, COMMES GRAINED SAMD, GRAVEL TO 3 INCHES, REFUSAL AT 19-0 FEET, MATER AT 19-5 FEET-
				₩	55	7	16	
	SAN SM	_		_			11	SMID/SILTY SMID: BROWN-MULTICOLORED SAFERATED, FINE TO COURSE GRAINED SMID, FEW GRAVEL TO Z INCHES.
				Ψ	90	5		
29-1 30-0	1		34	,	33	77		SAMY SILT: BROWN, WET, CHESIVE, FINE GRAINED SAND, OCCASIONAL GRAVEL-

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NEPT4	L05	٠.	Ü,	FI	-4	-200	N	DESCRIPTION
	SW/SM			*	98	12		SAME/SILTY SAME: TAN, DRY TO MOIST, LODGE, FINE GRAINED SAME-
1:1								
	SM	5		192	98		12	SILTY SMID: TWO, MOIST, MEDIUM DENSE, FINE GRAIMED SMID, OCCASIONAL ROUNDED TO SUBROUNDED GRAMEL TO 1/2 INCH-
5.0				₽.	_35	38		SAFE: DANK BROWN, MOIST, COMESTI S.
							6	SAND/SILTY SAND: Brown, SLIGHT CONESION, FEN SUBROUNDED GRAVEL TO 3/4 INCHES-
		8		æ	93			
	SM/SM						9	SAME: MOIST, FIN GRAVEL TO 2 INCHES, SUME ROOTS, SOME COMMLES AT 10.0 PERT.
				NP	93	11		
							,	SM4: ROOTS AND BARBED WIRE AT 14-5 FEET-
14.5								
5.0	581_			19	_35_	20		SILTY SAIPS: ROOM, HOLST, SOME COMESTON, COAPISE GRAINED SAID:
	SW/\$H	8		咿	90	12	3R	SMID/SILTY SMID: BROWN, MOIST, FEN GRAVEL TO 2 INCHES, COMPLES TO 5 INCHES, REPURAL AT 16-D PEET DUE TO ROOK.
9.0								
			25	6	99	35		SILTY SAND/CLAYEY SAND: BROWN, MOIST, OCCASIONAL GRAVEL TO 2-1/2", CORRLES TO 5"
1 22.0								SAFE: LANGE BOLLDERS, DIFFICULT DRILLING, MATER AT 22-0
	SANSC							
			26	5	97	49		SAME: BANK BROWN, SLIGHT COMESTON, FINE GRAINED SAND, 1-1/7 * BOULDER AT 27-0*.
27.Q						-		

TH 84 - 1202

THB4-12	164-1202		STA	950+0	0G R			<u>FL</u> - 254±
DEPTH	LOG	ж	LL	Pſ	4	-200	N	DESCRIPTION
		_						SAND/SILTY SAND: BROWN, MOIST, GRAVEL TO REPUSAL AT 3-5 FEET DUE TO ROOK.
		4		κP	86	3		
							21R	
	SM/SM							
		9		¥P	94	12	R	SAME: GREY, SLIGHT CONESSION, ORGANIC SME: TO 1/2 INCH, REPUSAL AT 9-5 FEET.
12-0				40	90	10		SAFE: BROWN, FINE GRAINED GRAVEL-
<u> </u>	SM	9		NP	89	15	R	SILTY SAID: GREY, MOIST, SLIGHT COMESION REFUSAL AT 12.5 FEET
15.0	5P/SM			¥	64	5		GRAVELLY SANTY/SILTY GRAVELLY SANTY: BROWN ROUNDED TO SUB-MIGULAR GRAVEL , CORRLES TO
18-0	SH/SM		_	MP.	86	10	7 9	SMIT/SILTY SAVID: BROWN, MOIST, ROUNDED TO GRAVEL, COMMUNES TO 9 INCHES, POOKETS OF S AT 18-5 PEET DUE TO LARGE COMMUNES.
21.0 1 21.5	SM			_	75	4	R	GRAVELLY SAND: COARSE GRAINED GRAVEL, SU ROUNDED GRAVEL, AND COMMLES, MATER AT 21.5 REVERT AT 21.5 PEET, REPUSAL AT 21.5 FEET
24.0	3 5				91	4	R	SAMD: BROWN, ROUNDED TO SUBROUNDED, COARGRAVEL TO I INCH, REFUSAL AT 25.1 FEET.
27:0	SH/SH			¥p	97	9	6	SAND/STUTY SAND: BROWN, LODGE, 9216HT CO GRAINED SAND.
30-0	SPVSC		27.	<u>-</u>	96	15		STLTY SAMO/CLAYFY SAMD: BROWN, INCREASE GRAINED SAMD, REPUSAL AT 30 5 FEET.
33-0								
35.0	26				\$8	2	þ	SAND: BROWN-MULTICOLORED, DENSE, REF. "A.
36-0	SH/SM			МЬ	93	ó		SAND/SILTY SAND: BROWN-MULTICOLORES : #

NOTES

- TRENCHES
- 2 SEE PLATE
- 3 SEE TABLE TYPE OF EC
- 4 ALL TEST F THE LEVEE IN THE CHAI LEVEE

VALUE ENGINEERING PAYS

	s	TA 95	0+00 R			EL - 2541
	u	PI	4	-200		DESCRIPTION
		_				SME/SILTY SMED: BROWN, MOIST, GRAVEL TO 3 INCHES, REFUSAL AT 3.5 FEET DUE TO ROOK.
		咿	96	9		
					218	
_				12		SAME - SDEV. SLIGHT CONCEING. DREAMIC SMELL. INM REAMER
_				10	R	SME: SREY, SLIGHT CONESION, ORGANIC SMELL, FEN GRAFELS TO 1/2 INCH, REFUSAL AT 9.5 FEET. SME: BROWN, FINE GRAINED GRAFEL.
_		**	90			
		1P	80	15	*	SILTY SAMD: ERRY, MOIST, SLIGHT COMESION, OMEANIC SMELL NEEDS. AT 12.5 PEET-
-		₩	64	5		GRAVELLY SAMPLY TO STATE TO SUB- GRAVELLY SAMPLE OF GRAVEL, CORRUES TO 5 IMPLES-
-		NP	36	La .	72	SMP/STI-TY SAM" BROWN, HOLST, ROUNDED TO SUBROLUMED GRAVES, COBBLES TO 3 THOMES, POORETS OF GREY STLT, REPUSAT 18-5 FEET DUE TO LARGE CORRLES.
			75	4	ę	SRAYELY SAID COARSE GRAINED GRAVEL, SURROUNDED TO ROUNCED GRAVEL, MO CORNLES, MATER AT 21.5 FEET, ADDING REVERT AT 21.5 FEET DUE TO ROOK.
			91	4		SAMP ROCH POLNDED TO SUBROUNDED, COARSE SRAINED GRAVE, TO 1 1954, REFUSAL AT 75-7 FEET.
~		·	37	9	5	SMIDIST TO SMITE. BROWN, LODGE, SLIGHT COMESTON, FINE GRAINED SAND.
_	7:	5	96	15		SILTY SAMO-TLAYON SAMO BROWN, INCREASE IN CONESION, RIN SPAINED CHEN PERIOR, AV 50.5 REET.
-			36	2	2	SMID BROWNING FECUNDAL DENSE REF-ISAL AT \$3.5 FEET.

TH84 - 1203 TH84-1203 #" STA 950+00 L EL. 2531 DEPTH LOS MC LL PT -4 -200 M SILTY SAMO: MOIST, LOOSE, FINE GRAINED SAMO, ROLLINED PINE GRAINED GRAVEL TO 1/2 INCHES, 1 INCH PROCETS OF FINER MATERIAL. P 97 14 ₩P 99 31 1¢ 41 16 100 84 SAMBY CLAY: BROWN, MOIST, SOFT TO STREET, COMESTIVE. 4 MP 98 11 5 SAMD/SILTY SAMD: LIGHT TAN, MOIST, OCCASIONAL ROLNDED GRAVEL TO 1/A INCHES, CAVING AT 8-0 FEET. SW/SM MP 96 10 10 SAME: PROOM, COARSE GRAINED SAMO, FBM GRAVEL TO 3 INCHES. SOME POCKETS OF SILT, ADDRED MUD AT 9-0 FEET DUE TO CANING. 92/98 12-0 68 3 17 3 INCHES. ROOM, CHARSE GRAINED SAME, GRANEL TO GRAVELLY SAND/SILTY GRAVELLY SAND: MULTICOLORED, MOIST, COMPSE GRAINED SAND, GRAVEL TO 3 INCHES, REPUSAL TIME TO PRO-MP 72 3 34 CAME. COMBLES TO 6 INCHES-24-0 61 12 COANCILY SIME MULTICALOPED, MOIST, COMPSE GRAIMEN SAND, 13 CRAFEL IN 3 INDIES: 25.0 59/54 SAMPLESTON SAME. REGION, MOIST, MEDIUM DENSE TO LINDSE, SLIGHT CONESTON, GRANE, TO 1-17 INCH. GREATH TO THE THE TRUTTE OF THE THE CHARGE SPANNER SAME. iju t SILTY SMY: "NANK BROWN, SLISHT COMESION, FINE GRAINED SAME, BY MIDED GRAMEL TO 1 INCH, CORPLES TO 1 FEET, ROLLPED SOLLDERS TO 1-1/2/.

SCALE I N-3FT

NOTES

I SEE PLATE 12 FOR LOCATION OF TEST HOLES AND TEST

35.Q_____

- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
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SYMBOX	SECUTIONS	BAR APROVA						
	REVISIONS							
	u.	S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS						
CERCONED SY.	SANTA ANA RIVER N PHASE II GENERAL D	IAINSTÉM, CALIFORNIA ESIGN MEMORANDUM						
50A-W711 ST.	LOGS OF INVESTIGATIONS							
	CORPS OF E	ENGINEERS						
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TH84-1205

THB4-12	05		S	TA 9294	00 R		EL · 248*					
DEPTH	L06	MC	LL	Pl	-4	-200	*	DESCRIPTION				
	SW/SM	6		₩	85	10		SAND/SILTY SAND: BROWN, MOIST, LOOSE, GRAVEL TO 1 INCH.				
3.0							30	STELTY SAVID: BROWN, MOIST, FEW GRAVEL TO ? INCHES. SOME CLUPPS OF SILT.				
	SM	_		HP.	92		30	SAME: GREY, SLIGHT CONESION, OCCASIONAL GRAVEL TO 1 INC				
				NP	92	19	30					
12.0							30	SAMP/SILTY SAMP: LIGHT BROWN, MOIST, FINE TO COARSE GRANNED SAMO, SRAMEL TO I INCH.				
	5x/\$M	5		HP	97	3	30	SAME: MATER AT 12 PEET, USING MID AT 13.0 PEET.				
113.0												
	SH			₩	33	15		SILTY SMIT: GREY TO BROWN, MOIST, SLIGHT COHESION, FINE TO COURSE GRAINED SMID, GRAVEL TO 1-1/2 INCHES-				
21.1	SH/SH			₩.	91	7	258	SAND/SILTY SAND: MULTICOLORED, WET, FINE TO COARSE SAND, FEM GRAVEL TO 1-1/2 INCHES, 5 PERCENT IDERLES TO A INCHES.				
24.0							柳	GRAFFLLY SARD: PLLTICOLORED, HET, COARSE SPAINED SAND, GRAFFL TO 2 INCHES, 10 PERCENT CHARLES TO 5 INCHES.				
	&				73	?						
50.0							3					
							19					
	5₩				73	3						
s. n							15					

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VALUE ENGINEERING PAYS

TH84-1206

TH84-12	06		ST	A 930+	30 L			FL - 2482
BEPTH	L06	HC	ш	PI	-4	-290	H	PESCRIPTION
			27	_10	85			GRAFELLY CLAYEY SAMI): DARK BROWN, MOIST, COMESE GRAINED SAMO, ROUNDED TO SERROUNDED GRANEL TO 2-1/7 INCHES, REVANDED COBLES TO 6 INCHES, REVERTIENT STOME TO 12 INCHES AT 2 FREET, 3 INCH SILTY/CLAYEY CONESIVE CLUMPS.
							?9	CLAYEY SAMP: SAME AS ABOVE
	sc	u	25	11	36	40		
							26	GRAVELLY CLAYEY SAND: SAME AS ABOVE, MEDIUM DENSE, ROLADED GRAVEL TO 1 INCH, CORBLES TO 1 FOOT, DIFFICULT DRILLING-
		11	26	19	79	28		
11-0							16	
								SILTY SAMP/CLAYEY SAMP. DARK GREY, HOIST, MEDIUM DENSE, SLISHT CONESION. CORRSE GRAJHED SAMD, FEW ROUMED TO SAP- ROUMED GAMEL. CORBLES TO 5 INCHES, ORGANIC SMELL, STEEL CAPLE AT 13-0 FEET.
	SM/SC		27	7	94	4?		
								SME: For GRAVEL TO 3 INCHES, COMBLES TO 9 INCHES, ORGANIC SMELL-
13.0						<u>-</u>	2?	GRAVELLY CLAYEY SAMP: FAREY, MOIST, MED. DEMSE, COHESIVE.
	SC		29	8	83	37		
							20	
25-5		_	11	1ª	32	33		SUMPS: PARK PROMIN ROUNDED TO SUBBOUNDED RPAYEL, \$ INCH SILTY/CLAYEY CLUMPS.
ω.,_	54		29	7	94	37		CRANFILLY SILTY SAID: SREY, MOIST, MEDIUM DENSE, SLIGHT CHRESION, ORGANIC SMELL, COMESE BRAINED SAND, MOINDED TO SURROUNDED GRAVEL TO 1 INCH, 5 PERCENT COMBLES
Z9-0							29	
<u> </u>						-		CLAYEY SAND: GREY SAND, POCKETS OF BROWN CONESIVE CLAYER CLAYES, FEW GRAVEL TO 1/2 INCH, 5 PERCENT CORBLES TO 5" DIFFICALT DRILLING DUE TO MOLLDERS.
	sc		27	9	93	35	15	

NOTES

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	REVISIONS		
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05.500 40 0 87.	SANTA ANA RIVER MAINSTEM, CAI PHASE II GENERAL DESIGN MEMOR	LIFORNIA RANDUM	
STATE OF	LOGS OF INVESTIGATION	ONS	
	CORPS OF ENGINEER	S	
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TH84-1207

D 84- 12	107		ST	A 9204	00 R		£L- 2 %6 ±				
EPTH	L06	ric.	u.	PĮ	4	-200	N	DESCRIPTION			
								GRAVELLY SAND/SILTY GRAVELLY SAND: BROWN, MOIST, FINE TO COMISE GRAINED SAND, GRAVEL TO 1-1/2 INCH-			
		4		JP.	8 5_	9_		SAND/SILTY SAND: SAME, SOME CORRLES-			
	SW/SM			HP	88	11	25R	SAPE: REPUSAL At 7:0 FEET DUE TO BOULDER.			
1.0					<u></u>			SAND: LIGHT BROWN, MOIST, FINE GRAINED SAND, FEW GRAVEL			
2.0	5 9				94	•		TO I INCH-			
	SPI			P	95	19		SILTY SAND: GREY, MOIST, SLIGHT COMESION, FINE GRAINED SAND-			
<u> </u>					90		164	SAND/SILTY SAND: GREY, MOIST, FINE GRAINED SAND, SOME COMBLES, REFUSAL AT 16-0 FRET.			
							36	SAME: MOIST TO WET, FINE TO COARSE GRAINED SAND, FEW GRAVEL TO 1 INCH-			
	SW/SM	9		NР	37	,	20				
22.5							239	SME: REPUSAL AT 22-0 FEET, MATER AT 27-5 FOOT, HSING PLO AT 22-5 FREET.			
9-0_					~		3	GRAVELLY SMITH: MULTICOLORED, WET, LOOSE TO MEDIUM DENSE COMMISS GRAINED SAND, SRAVEL TO \$ INCHES. 5 PERCENT COMMISS.			
	4				. 64						
					50	2	18				
0.0											

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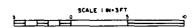
LUE ENGINEERING PAYS

TH83-1208

TH 64 -1	208			7A 910	-00 L			EL - 2432
DEPTH	LØ6	ric .	u	PĮ	4	-200	*	DESCRIPTION
	2M/2M			₩	85	12	23	SAND/SILTY SAND: BROWN, MEDIUM DENSE, COARSE GRAINED SAND, COMBLES TO 12 INCHES-
3.0							2₩	
	R.			*	98	57	9	SAMPLY SILTY: THE-BROWN, MOIST, LOOSE, FINE GRAINED SAMD-
6.0								SILTY SAND: TAN-BROWN, MOIST, LOOSE, MEDIUM SRAINED SAND
	SM			WP	98	16	18	
								SAFE: PREDIUM DENSE-
11.5							19	SAND/SILTY SAND: TAN-BROWN, MOIST, MEDIUM GRAINED SAND-
								SAME: MET, MEDIUM TO COMPSE GRAINED SAME-
W 16				_¥_	95_	10	25	SRAYELLY SAMINSTLTY GRAMELLY SAMI: SARY, MET, MEDIUM
10								DEMSE, COMPSE SRAIMED SAMP MODED REVERT AT 15.5 FEET-
				Ψ	85	6	19	
	2M/AH							
							12	SAME/SILTY SAMP: GREY, WET, WEDI/M DENSE, COMPSE GRAINED
								SAND
							17	
				Ψ	99	11	12	
52.0_							21	
							15	SILTY SMIT: GRAY, MET, MEDIUM DEVISE, MEDIUM TO COARSE GRAIMED SMID-
	24			₩	99	14		
35-3					- -			

NOTES.

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STANSOL.	WIGHTON.	DATE APPROVA
	REVISIONS	
	l lo	PENGINEER DISTRICT DS ANGELES S OF ENGINEERS
0600Q+400 BY.	SANTA ANA RIVER MAINSTEN PHASE II GENERAL DESIGN M	
COANTE ST.	LOGS OF INVESTIGA	ATIONS
-	CORPS OF ENGIN	EERS
	STA.920+00 TO STA	.910+00

VALUE ENGINEERING

WM74-5

LOS OF SORBIS 5

7				1 2	7 E	F	Γ
Mary II	1		BESCRIPTION	¥ E	1	1	
URF4	""	LEVATI	#8: ≥ 263' Fill: Leoce, dry, brown SILTY SAMD (SN)	$\overline{}$	_	$\overline{}$	T
7	Ш		Fill: Loses to medium dense, damp, brown CRAVELLY SAND (RM-RM)	-	l	ł	ł
1	Ш	1		-	ł	ł	ł
•-	Ш			1	ł	l	ł
1	H	1		_}	1		l
1	11	1	Medium dense, damp to set, brown SARD (SU-GR) with CRAVEL	1	1	ł	l
	11			- 1	}		l
1	- {}	1		1	ł,		l
-	{}	ł	Yery dense, damp to wet, tam SAND (SP-SH) with GRAVEL	7	l		Į
	٠ H	>50			12	120	ľ
1		18		- [}		
4	U		Very stiff-hard, reddish-brown SILTY CLAY (CL)	\dashv			l
	;	50		_	16		ı
	ш		Very dense, raddish-brown SILIT SAMD (SP-SM) with GRAVEL				

WM74-6

	Ξ	Ξ	=	RIG Bushs, Recery with MOLE DIAMETER A 7/Ain. WEIGHT OF HAI
BEPTH, FT.	Same.	B.000 / POST	CHOUND METER	DESCRIPTION
SURFA		ì	ATK	ON ≈ 330
. 1				Fill: Loose, 617, brown SILTY SAMD (SN-SK) with CRAFEL Fill: Loose, 417, brown SILTY SAMD (SN-SK) with CRAFEL
, " –]				CLATER
	, 2	>50		Dense to very dense, damp, tan SANDY CRAYEL (CH-CH) to CRAYEL SAND (SU-SH)
"]	. 🛭	,,,	0	
}	,	l		Dense, zam SAND (SP)
*-	•	44		Very dense with GRAVEL
	1	Ц		Notion of bering 36 feet

WM74-9

MT70-10

TEST BORNE : On

TYPE		- 3	.44.	_	Τ-	-	_	E		П	ON 226 3 BORING NE
,	1		1	1				H		SP	Loose brown fine to coarse JANU 1 to scattered GPANSS
	1					. :	٠.	П	I	7	Very soft dark gray up-12 120
								H		SF	Loose to sentico pact crown ledic in coarse 3400
						- 1		H	l	Sa	Setti-combact trown fine 12%
							٠,			sc	Stour fine JLAYER JANU
										50	Srown time (AV)
								H			Elitor Attit Serv
								Н	1	إناذ	3room fine it. it she
								H		50	Grown from to usersa office one mayon
								Ш	Ü	SC.	Redigrown time (1) to the claser
	- 1							₩	4	۲	51 tak 10,1 U.S.
								Ш	7	5	prove fine to coarse to act police.
								Щ	Ų	3	rown fire to coards at many an
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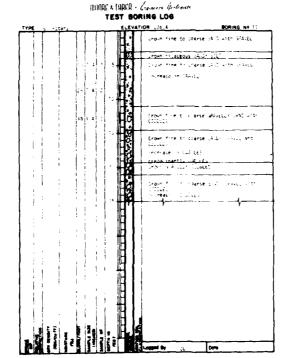
WM74-6 LOS OF BORNS 6 5 June 74 WATER DEPTH 12" DATE MEASURED 19 June74 SAMPLES Fitcher and Calif. Mos. 6 buffe, Rotary usts HOLE DIAMETER 4 7/Ain. WEIGHT OF HAMMER 1401bg FALLING 30th Fill: Loose, Sry, brown SILIT SAMD (SH) OR SILTY SAND (SU-SH) WITH GRAVEL] aum Dennes to very donne, domp, can SAMDY GRAVEL (CH-CH) to GRAVELLY SAMD SAMD (SH-SH) 11 125 Dense, two SAME (SP) 13 117 54 Tory dentes with CRAFFL Section of bering 35 feet

WM74-7 LOS OF SORMS 7 DATE OF BORING 12 June 74 WATER DEPTH DATE MEASURED TYPE OF DRILL RIG RESTY WESH MOLE DIAMETER 4 3/410. WEISHT SAMPLES Pitcher and Calif. Mod. MOLE DIAMETER 4 3/4th. WEIGHT OF HAMMER 1401bs. DESCRIPTION Fill: Longe, dry. brown SILTY SAID (St) with CORSLES Fill: Hedium dense, damp ton SAND (SP) Medium dense, moist, dark brown CLATEY SARD (SU-SC) with GRAVEL 7 112 Dense to very dense, tan SAND (SP-SH) with GRAVEL 103 12 124 54 12 114 Very dense, tan SAMD (SP) with GRAVEL 17 109 This layer of brows SARDY CLAY (CL) Sector of boring 625 feet

MT70-10

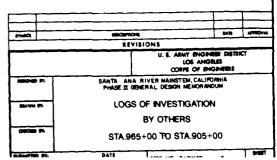
TEST BORING LOG CLEVATOR SPA SECULATION SAFE SECULATION SPA SECULATION SAFE SECULATION

MT70-11



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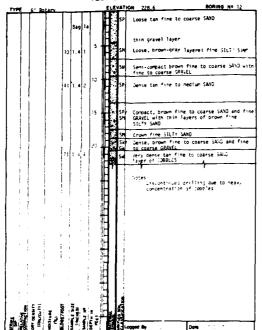
- I. SEE PLATE 12 FOR TEST SITE LOCATIONS
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE



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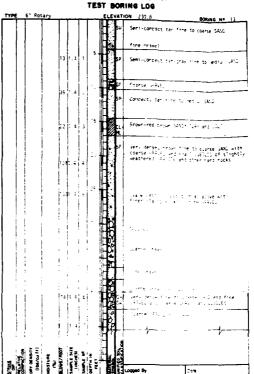
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MANAC & TABLE - Legisters - Goldenste TEST BORING LOG



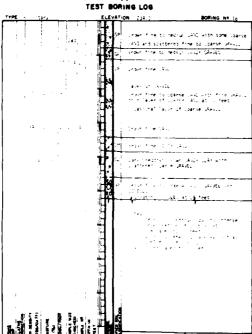
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MT 70-17

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fine to quarse SAME with a small (1380LC) of sirghtly and other hard rocks

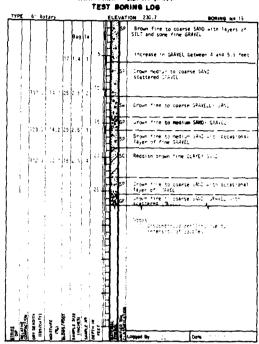
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Comments and fine to coarse SACC and fine 3 years and the 3 years and the 3 years and the 3 years and the 3 years and the 3 years and the 4 years and the 4 years and the 4 years and the 4 years and the 4 years and 4 years	TYPE	6 · 2				EST 80	Consider Control of the Control of t
Community, pressure to course out of the Secretary of the		<u> </u>	T				. Compact tan fine to coarse SAUC and fine the
Sense can fine to coarse until fine 20 Sense can fine 20 Sens					ا د	#	Compact, gray time to course (10% 51%)
Sente can fine to coarse on the fine included and course for the coarse of the coarse			1	24 : 4 	2		LOCUALT tan fine to coarse Jacobia fine GRAVEL
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SE COTTENT STORM OF THE SE OCCUPANT SANCE OF THE SECOND STATE SANCE OF THE SANCE OF THE SECOND STATE SANCE OF THE SECOND STATE SANCE OF THE SANCE OF							
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S Carettermonia equal Standard							The mode has note to compact out of the compact of
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							Dense to wery dense familine to coarse (ACC with stattered rine and coarse (ACC)
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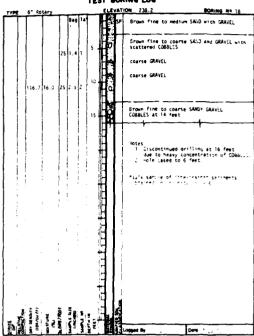
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SYMBOL	очеснитона		DATE	APPROVA
	REVI	SIONS		
		U. S. AMMY BNG LOS AN CORPS OF B	GBLES	7
CRECHED BY.		RIVER MAINSTEM, CALI MERAL DESIGN MEMOR		
MANN BY.	LOGS	OF INVESTIGATIO	M	
09000 FT.		BY OTHERS		
1	STA.965+	00 TO STA.905+	00	
BURNATTED BY.	DATE	SPEC. NO. DACWOP.		SHEET

VALUE ENGINEERING PA

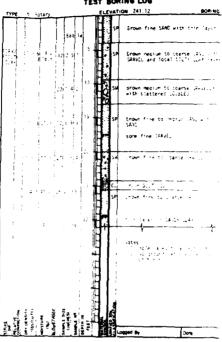
MT70-18

MORE & TARER - Learners Genterists
TEST BORING LOG



MT70-19

MODEL TARER - Conners Geologists
TEST BORING LOG

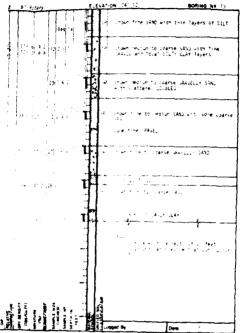


Тура	10	ъ" э. Т	· · ·		ezer T	_	φ ₀	h ni		F64-13 ************************************
	53 ¢.		-	~	-	7.	.4		-	eroen fine to coarse sand with gra-
	225						,4			
1104	22 0							, ,		arms. fine to very coarse sand with some orace.
	210		-	_			, <].		
	205						1			Swring control on fabric steep rise extend ing out if six th concrete protested but degree for few too of beni. S. Or to be seen the control of the control
			-	_	5					15' matter that we needed to revance belong creaturable exting below ground water. Tolonate 10 feet because of large are at 6 feet depth on first location.
		Dry demarty (135 on ft.)		ŝ	Stand Perefresion (Blows/Ref)	Somple with	Semple at		Unified 10?	

ypa	16" Dieset Auger	MT64-14 G.L. = 233-01 Top Hole (levation process)	BORING NO. 14 Completed + 2,15-14
23 !		Some for the core	od MCD: scattered
22			
275 275 275 215			sand with some erayel
		No.	I slow storex. To smarthed them addend wisk, 200, 100 or of the 234, a need in Enterth inter to committee to
	Ory density (16s. ca.ft) (4c) (5s. ca.ft) (6s. ca.ft) (6s. ca.ft) (6s. ca.ft) (6s. ca.ft) (6s. ca.ft) (6s. ca.ft) (6s. ca.ft) (6s. ca.ft) (6s. ca.ft) (6s. ca.ft)	S 337 (W 2)	

MT70-19

MARRIE TURES Comment Verlager



MT70-20

MINIAR & TARER . Conneces Geologists

_	61	Ro	ary			_		ELE	VAT	ION 246.6 BORING Nº 20
[-	T	Bag	10			SP	Brown wedium coarse SAND with occasional layer of dark prown SILT
						1		Ħ.		layer of SRAYEL
	e2. ∴	5	30. 34.	; <u> </u> .	i.5	ŀ	5	#	7,	Dark gray micaceous fine pAND with layers of SILT (organic)
					İ		}	H.	S.	arown fine to coarse GRAVELLY SAME
		į		13	1 4	2	12	11:		toto layer of oxidized SILTY GLAY
		ļ		-	!		!	H		COBOLES
		į			}	ì		Ho		scattered COBBLES
ı ı i		i		l _e	 -]]	1'3	H	SP	Srown fine to medium SAND wit SPALEL and occasional Cooble
		j		-		1		H:	SJ	Grown fine to coarse SANG and JPAVEL
		1	16	15	. 5	:	4.7	П.	Н	
		1		1	į	İ		12	3	rown fire to coarse SRA/EL afth Libbur.
		,		Ì	1		25	Η.	ì.	Grown fire to quarse IANS with fine GPA-Es
				į	1	Ì		HZ	32	main DRAVIL and Cossils
1	٠,	i		Ι,	: 2 5			H		crown fine to toarse SARCOCK SAND
							10	Щ		
		i			1					intes of elual at this feet
		į		1	į			\mathbf{H}		المعدد در دوم دام ۱۹۰۰ و الهي وکړيه .
. :						i		H	ł	market 1 control 1
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					:		•	П	} ;	
					i			#	la	
9		Ē	¥	2	38	1	ŗ	H.	á	
- 7	8	ž'	2:	è	179	2	: 5	- 1	B	inner St.
		એ.ં		0; e2:5 33 1: C.o. 34.	5; e2.5 33.3 2 C. 6 34.7	8 as 3 as 3 as 3 as 3 as 3 as 3 as 3 as	6 es la 6 es l		6 es la estada del estada de la estada del estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada del estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada de la estada del estada de la estad	Section 1

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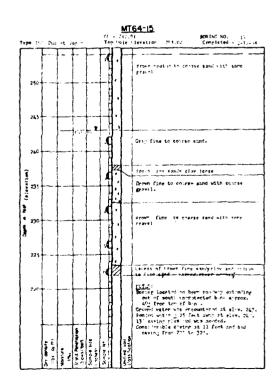
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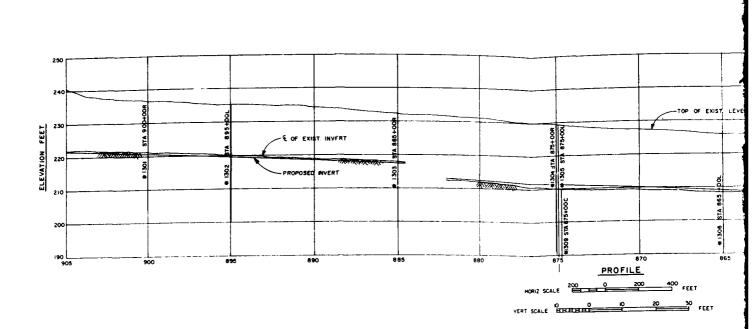


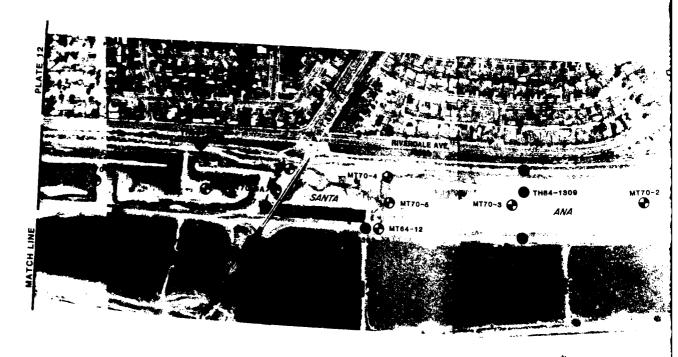
NOTES:

- 1. SEE PLATE 12 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

				1						
SYMBOL	DESCRIPTIONS		DATE	APPROVA						
	REVISI	DHS								
		U. S. ARMY ENGEN LOS ANG CORPS OF EN	R.ES	CT						
SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM										
BRAWN SV.	LOGS OF INVESTIGATION									
GROSS IN	BY OTHERS									
Ì	STA.965+00 TO STA.905+00									
MANITTED BY:	DATE	SPEC. NO. BACW 09-		SHOPET						

VALUE ENGINEERING PAY

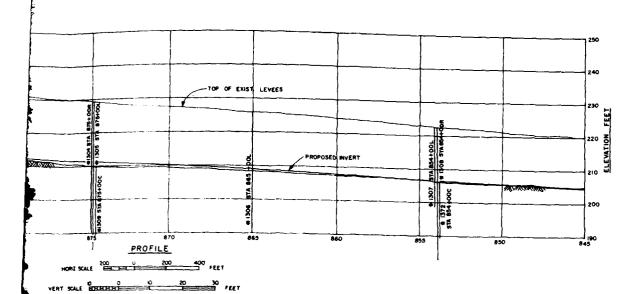






NOTES:

VALUE ENGINEERING PAYS







NOTES:

1. SEE PLATE 8 FOR LEGEND AND GENERAL NOTES.

2. SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF AVESTIGATIONS.

			+						
SYMBOL	DESCRIPTIONS.	9479	AFFROVA						
	REVISIONS								
		AY BNGWEIR DISTI LOS ANGELES PS OF ENGINEERS	iict						
0050HB 611		ANA RIVER MAINSTEM. CALIFORNIA SE II GENERAL DESIGN MEMORANDUM							
SQAWN SY.	PLAN AND PROFILE								
OROSE PH	STA 905+00 TO STA 845+00								

VALUE ENGINEERING

TH84-1301

M M-1 3	101		S	A 9004	00 R			EL · 257±			
DEPTH	L06	MC	u	PĮ	4	-200		DESCRIPTION			
				102	90			SAMB/SILTY SAMB: BROWN, MOIST. FEW GRAVEL TO 3/4 INCHES. 3 INCH AC AT SUMPACE.			
	SW/SM	_		NP.	90	12	R	SAME: DANK BROWN, COARSE GRAINED SAMD, FEW GRAVEL TO 1/2 INCH, REPUSAL AT 2-0 FEET-			
								SAFE: FEN GRAVEL TO 1-1/2 INCHES, REPUSAL AT 5-0 FEET-			
6.0				NP	90	10	R				
	SPA			φ	93	19_		SILTY SAMD: DARK BROWN, MOIST, COARSE GRAINED SAMD, FEW GRAVEL TO 1/2 INCH, REFUSAL AT 8.5 FEET DUE TO ROCK-			
		-		•	83	16	7 9 8	SILTY GRAVELLY SAMD: BANK BROWN AND GREY, MOIST, GRAVEL TO 1 INCH-			
10.5								SILTY SMM: GREY, MOIST, COARSE GRAINED, SAND, FEN GRAVE 1-1/2 INDES:			
12.0	SM/SM			MP.	88	16		SAMD/SILTY SAMD: GREY, MOIST, COARSE GRAINED SAMD, GRAVE TO 1-1/2 LINCHES.			
								SILTY SAMO: SREY, MOIST, DENSE, COMPSE GRAINED SAMD, FEW GRAVEL TO 1/2 INCH, REPUSAL AT 14-5 FEET-			
		_			92	15	29R	SAME: MATER AT 17-5 FEET, ADDING MLD AT 17-5 FEET-			
	SH							SATE: MAILER AT 17-3 PEET, MUNIME HUD AT 17-3 PEET-			
<u>¥ 17 4</u>				MP.	91		36				
1.1				₩	91	13	5				
	SM/SM			NP	92	9		SRAWFILY SAND/SILTY GRAVFILY SAND: TAN, COARSE GRAINED SAND, GRAVEL TO 2 INCHES			
29.0							20				
	SM			φ	95	14		SILTY SMID: BROWN-TAN, SLIGHT CONESION, FEW GRAVEL TO 2 INCHES:			
27.0							10				
	SP/SH				90	12		SAMD/SILTY SAMD: LIGHT THE, SLIGHT COMESTON, COARSE GRAINED SAMD, FEW GRAFEL TO 1/? INCH-			
5 0.0							19				
				_				SAFE: Few grands. TO 3 INCHES, FEW COMMUNES TO 4 INCHES, NO SPT AT 33:0 PRET DUE TO COMMUNES.			
33.a _	SM/SPI			¥	97	11					

TH84-1302

£.:			02	THB4-1302				
Desca	4	-200	4	Ρļ	u.	ж	L%	DEPTH
AND/SILTY SAND: RECION, M SAND, REFUSAL AT 2-5 FEET-	9 5							
SAFE: TAN-BROWN	98.	6_	86	Ψ.		5		
. In sum:	•	11.	97	. 9		3_		
SAFE: FEDIUM DEMSE-	5							
	R					4		
	22	5	96	*		4	SP/5₩	
	17					<i>:</i> _		M: 16-5
SAFE: WET, WATER AT 15.5							•	B: 10-2
SAFE: LOOSE-	9	12	93	•		. –		
GRAVELLY SAND/SILTY GRAVE		9	85	•		·	SH-SH	21.0
STLTY SAND: TAN-BROWN, will COMMILES, MEMUSAL AT 23-0			99	Ψ.				22 <u>-0</u>
	_							
REFUSAL AT 26-0 FEET TO R SAPE: SREEN, FINE BRAINE		33_	. 89					
SAPE: SREEN W/ LENS OF PI		29 25	100	*		2 <u>7.</u> 78	<₩	
	50 °							
		39	100	₩.		15		
		59	100			15		

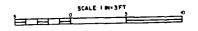
TH84-1302

•	STA 8	195+	90 L			EL - 2562					
MC .	LI, F	-1	4	-200	1	Description					
					7 9	SAMO/SILTY SAMD: BROWN, MOIST, DENSE, COARSE GRAINED SAMO, REFUSAL AT 2.5 FEET.					
<u>.</u>		₽_	<u> 16</u>		198	SANE TAN-BROWN.					
<u>ا</u> ۔۔۔		₽	97	ш.		SAME MEDIUM DENSE-					
•	-				٠						
<u> 4</u>	•	₽	96	5	n						
1_	-				;7	SATE MET, MATER AT 15.5 FEET, ADDING REVERT AT 15.5.					
	······································	φ	93	12	3	SAPE : : :: :: :: :: :: :: :: :: :: :: :: :					
		P	85	9		GRAVELLY SAND/SELTY GRAVELLY SAND: SAME AS ABOVE, FEM COMM. 25-					
		P.	. 99	25		SILTY SMID: THE BROWN, NET, COMPSE GRAINED SMID, FEM COMMES. HERISAL AT 23-D REET DUE TO MODIS:					
<u>.</u>		ę.	<u>a9</u>	55	•	REFUSAL AT 25:0 FEET TO MINCES. SARE THEM, FINE GRAINED SAND.					
27	!	¥_	100	28_		THE THE WAS CHANGED SHEET					
78		P	100	25	٠	SATE: GREEN W/ LENS OF PINK, VERY DBNSE, REPUSAL AT 29.0° SATE: Green, sine in coarse grained, repusal at 32.5 FT.					
. –					50e						
15	,	.	100	**9							

NO

TH84-1303

(HB4-1303			S	A 885+	00 R		EL. 2332				
DEPTH	L06	rk.	Łi,	PI	4	-200	ĸ	DESCRIPTION			
1.5	SP/SM			Ψ	98	5	R	SAMD/SILTY SAMD: TAN-BROWN, DRY, CORRLES TO 5 INCHES.			
3.0	SW/SM			MP.	91	10	30A	SAME: DARK BROWN, DENSE, REFUSAL AT 2-5" DUE TO GRAVEL-			
				₩P	91	13	34	STLTY SAND: DANK BROWN, DRY, DENSE-			
	SM							SAME: GREY, FBH GRAVEL TO 3 INCHES, FBH COBALES-			
				Ψ	_99_	13_	,	SATE: FOR GRAVEL TO 3", COMPLES TO 6", REPUSAL AT 8-0 FEET DUF TO GRAVEL.			
12.0		8		\p	90	16	ę				
	SW/SM	,			91	ii		SAMD/SILTY SAMD: SREY, MOIST, DENSE, REPUSAL AT 14-7 PEET DUE TO GRAMEL:			
15.0_							R				
	20/2H	ă.		_£ .	_31_		•	REMISAL AT 17-9 FEET DUE TO SPRANEL.			
19 5 W 36	0 54/54	10		*				SRAVELLY SAMPUSILTY GRAVELLY SAMPL. SAME AS ARONE, THAT SHEY, WATER AT 19-5 FEET.			
	· .							QUAYEV GRANELLY SAND: BROWN-THM, MET, NO SPT AT 29-3 FEET DIE TO COMBLES-			
	sc	51		11	66			SAFE: Time			
							6	QUYEY SAMD: TAN-BACHA, LYDSE-			
			+3	29	34	45					
26.0	1			¥F	31		20	SAMOY STUT - FREY-THN, COARSE GRAINED SAMO-			
<u>28.0</u>					35		. 20	SAND GREY-TAN, COARSE GRAIMED SAND-			
\$0.0						·	19				
	SW/SP			'p	97	5		SAMP/SZLÍY SAMD: GREY-TAN, MICOLUM DIENSE, COARSE GRALINED SAND-			
33.0							. 19				
35.0	9P/SH		1.		39	12	_				



NOTES:

- 1 SEE PLATE 13 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2. SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3. SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS STHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

		 							
SYMBOL	REVISIONS	BAR) Amount						
	U. S. ARMY BYGE LOS AND CORPS OF BY	PEL25	CT						
0000-00 EV.	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM								
INAWA ST.	LOGS OF INVESTIGATIONS								
!	CORPS OF ENGINEERS								
OHOMO PA	STA.900+00 TO STA.885+00								
SUBMITTED BY:	DATE APPECMEN SPEC. NO. DACWOP.		SHEET						

VALUE ENGINEERING I

<u>TH84 — 1304</u>

THBA-1	304			STA &	75+00 R			EL- 290±
DEPTH	L06	Æ	Ц	. P	-	-200	Ħ	RESCRIPTION
			_		96	10		SAND/STLTY SAND: BROWN, MOIST, COMBLES TO 12 INCHES-
	SWSM	3		w	91	9	60R	SAFE: DENSE, COMBLES TO 6", REPUSAL AT 2-5" DUE TO GRAVEL-
6.0							439.	SAFE: Dringe, comples to 4", repusal at 5.5" due to gravel.
		٩					198	GRAVELLY SAND/SILTY GRAVELLY SAND: SAME, REPUSAL AT 8-5" DUE TO ROCK-
	SP/SM	5		HP	80	7	194	SAME: MOIST, GRAVEL TO 5/4", REPUSAL AT 11-0" DUE TO ROOK-
12.0							R	
		5		ĸ	85	8	32 9	SAME: ROUSE, TO 2", REPUBL. AT 14.5" DUE TO ROOK. SAME: ROUSE, GRAVEL TO 1", SOME COMMETTE DERRIS TO 4", REPUBL. AT 17.5" DUE TO ROOK.
	SW/SM	3					36R	
19-5		11 19		нP	98	9		SAMD/SILTY SAMD: SAME, MOIST TO MET. SAME: LIGHT BROWN, WET, WATER AT 19.5'.
							22	SAME: TAN-BROWN, COARSE GRAINED SAND-
		_	_	NP	90	8	23	
z.g							20	
8-0		22_			87_			SAND: REDDISH TAN, CORRSE GRAINED SAND-
1.0	a.	n	33	16	100	69	24	SANDY CLAY: REDDISH TANK STIFF.
	SM	25	23	2	74	37	R	GRAVELLY SILTY SAND: REDDISH TAM, MEDIUM DENSE, REPUSAL AT 72-0 DIE TO ROOKS-
5.5				₽_	71	24		SILTY SRAWELLY SAMO; SAME, NO SPT AT 35-0' DUE TO BOOKS-
4.5	SH-SM			₩	55	9		GRAVELLY SARTI/STLTY GRAVELLY SARTI: REDDISH TAM, MEY, POLL DERS TO 16" AT 58-5", NO SPT AT 58-0" DUE TO ROCKS.

TH84 -- 1309

TH84-1309		S	TA 875	+00 C			EL. 210±	
٤06	MC	ц	P1	4	-200	*	DESCRIPTION	
						6	GRAVELLY SAND: LIGHT BROWN, MOIST TO HET COMISE GRAINED SAND, GRAVEL TO 1/2", WATE	
				73	1			
30						3		
							SAMO: MULTICOLOGO, HET, LOOSE, COARSE SH	
				35	4		GRAVEL TO 3 IMCHES-	
						16	SAMITY GRAVEL: PROME, MET, MEDIUM TIBNSE, SAMO-	
GΡ	-		_	46				
						16		
64/6C		27	7	58	23	[R	SILTY SMMY GRAVEL/CLAYEY SMMY GRAVEL: MET, COMPSE GRAVMED SMMD, GRAVEL TO \$ INC TO \$ INCHES, SOME CLUPPS OF CLAYEY SILT, 15-0 FRET-	
2b\2¥	3			95	s	15	SAMP/SILTY SAMP: DANK IMPON, MET, MEDIUM CONESTON, FINE GRAINED SAMD, FEN GRAME, T	
	\$P	SP SP SA/SC	\$9 FP GA/6C 27	\$P	106 MC LL P1 4 73 59 55 69 68 68/6C 27 7 58	1.05 AC LL PI 4 -200 73 1 \$9 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 4 \$6 5 \$6 4 \$6 4 \$6 5 \$6 5 \$6 4 \$6 5	106 NC LL P1 -4 -700 N 6 73 1 59 35 4 16 69 48 4 16 69/6C 27 7 58 23	

ALUE ENGINEERING PAYS

TH84 - 1309

S1	A 875+	00 C			EF: 510s				
<u>.</u>	Pl	4	-200	1	DESCRIPTION				
Г				δ	GRANCILY SAMP. LIGHT BROWN, MOIST TO MEY, LOOSE, FIME TO CORP. "PAINED SAMD, GRAWPL TO 1/2", MATTER AT 1.5 PEET-				
		73	1						
				3					
-					SAMP: "ULTICOLOED, NET, LOOSE, COARSE GRAINED SAMD, FEN				
		35	4		GRAME, 70 T INCHES-				
				15	SAMPY GRAVEL ROOM, WET, MEDIUM DENGE, "I'ME GRAINED SAMD.				
L		-							
ľ				16					
F -	,	99	23	Ĭŧ	SILTY SMAYY GRAVEL/CLAYEY SAMBY GRAVEL: NATIOOLONED, MET, COMPSE GRAVED SAMD, GRAVEL TO 3 PHONES, SOME COMPLE TO 3 INCHES, SOME CLAYES OF CLAYEY SILT, REPUSAL AF \$2.0 PEET.				
•		95	5	15	CANDISCON CARD DARK MODEL, MET, MEDIUM DENSE, SOME CONCESSOR, FINE GRAPH, TO \$ IMPLES.				

TH83-1305

TH83-13	05		ST	4 875+0	99 L			EL. 2291
DEPTH	1.06	HC	Щ	PĮ	-4	-200	×	DESCRIPTION
	SH/SH		-	#P	92	8	33 298	SMO/SILTY SAMD: BROWN, DENSE, COARSE GRAINED SAMD- SAME: CORBLES TO 4", REPUSAL AT 2-5".
	<i>3</i> 17.31			NP	93	9	49	
9.0	-				<u>-</u> -		15	
11.0	_8_		51_	. 72	99	70		SAMPLY SILT: BROWN, MOIST, COMESTVE, COMPSE GRAINED
							29	SAMB/SILTY SAMD: TAM-BROWN, MOIST, MEDIUM GRAINED SAMD-
				۱۴	99	3	32	SAME: COMPSE GRAINED SAND-
¥ 17.0							72	SAME: MET, MATER AT 17-0'-
	SW/SH						/2	SAME: "MOUNTIAN, COBBLES TO 5", NO SPT AT 20.0" DUE TO ROCKS-
				ND	87	,		SAME: COBALES TO 8", NO SPT AT 23.4 DUE TO POORS-
24.0								SAME: COMMLES TO 12 IMPHES
26.0			75	59	97	31	27	SAMBY SILT: GREEN, MOIST, SLIGHT CONESION, FINE GRAINED SAMD.
	494							SNF: SREEN WETH RUST COLOR-
30.0			75		_97_		26	
				₩	94	15	D	SILTY SAME: GREEN, WET, COARSS SPAINED SAME, I INCH LESS MUSTARD COLORER SILT. SAME: NO LENS OF SILT, REPUSAL AT \$1.97.
								SHE: NO LENS OF SHELLY MELONIC MARKET
	SH.	_			_		. •	REPUSAL AT \$5.01. SAME: FINE TO COMPSE CRAINED SAMO, CON TRAMEL, REPUSAL
				₩2	97	13	,	gt ²⁸ . ⁹ .
42.0							- 6	REFUSAL AT 41-2'
45.0	\$×/\$	•			- 99	3	,	SWO/SILTY SAMP: GREEN-RUST, WET, FINE TO COARSE GRAIN SAMD, FEW GRAVEL, REFUSAL AT 49.2.



NOTES:

- I SEE PLATE IS FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4. ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

								
STIMBOL	Mario4	DATE	APPROVA					
	REVIS	U. S. ARMY ENGINEER DISTRI LOS ANGELES CORPE OF ENGINEERS	G					
DESIGNATE BY.	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM							
BRAWH BY.	LOGS OF INVESTIGATIONS CORPS OF ENGINEERS							
GOOD IN	STA.875+00							
SUBMITIED BY:	DATE STAD	SPEC. NO. BACWOF B	94987					

VALUE ENGINEERING

TH83-I306

								17 1 1 1 1					
TH83-1306			:	STA 86	5+00 L			EL. 226±					
DEPTH	L06	MC	u	PI	-4	-200	H	DESCRIPTION					
				- 10	. 95			SAND/SILTY SAND: BROWN, MOIST, COMPSE GRAINED SAND, COM- BLES TO 8", BOULDER TO 24", NO SPT AT 0.5" DUE TO ROCKS-					
							24	SAME: MEDIUM DIEMSE, COMMLES TO 6 INCHES-					
		5		IP	91	6							
							20						
	SH/SM						,	SAPE: ORGANIC AND INDRGANIC DEBRIS AT 9.0, STEEL WIRE AN CAPLE, WERLSAL AT 8.0.					
	34735	15		NP	31	ın	•						
				NP.	95	7		NO SPT AT 11-0 FEET DUE TO ROOKS-					
								SAME: ADDING MATER AT 15-0 FEET QUE TO CAVING.					
15.0					·		35						
_	59/59							SME: TAN-BROWN, HET, COARSE GRAINED, REN GRAVEL, MO SPT AT 17-0 REET THE TO ROOKS, WATER AT 17-0 FEET-					
8.0				₩.	_95_								
	a.M.		29	,	100	65	55	SMITY SILT/SMITY (LAY: TAN-BROWN, NET, HARD, CONESIVE, FINE BRAINED SMID-					
27.0													
24.0			49	21	100		45	SAMPY SILT: TAM-BROWN, WET, HARD, COMESTVE, FEW FINE					
								SAMPY (LAY: TAN-BROWN, WET, HAND, COMESIVE, FINE GRAINED SAND.					
27.3	٥		35	14	100	81	41						
								SILTY SMBY GRAVEL: BROWN, MET, FINE TO COMPSE GRAINED SAND, COMMILES TO 4 INCHES.					
	64			*	53	13	35						
33.0								No SPT AT 32:0' DUE TO NORS:					
350	SP/6#			*	33	6		SAMOY GRAYFL/SILTY SAMOY GRAYFL: RRINA, MET, COARSE GRAINED SAMO, COMBLES TO 5 INCHES.					

TH63-1307

THB 4-1 507			S	IA 8544	09 L			न् . <i>??</i> ३±				
del 1	LOS,	**	tı	Pį	4	-200	*	uEacutation				
1.5.	SH/24	4			35_			SANT/SILTY SAMI: ARGUM, DENSE, SR COMPLES, REPUSAL AT 0.5" DAR TO HOOKS.				
3. 0	7	5			-53		•	SAMPY GRANTL: BROWN, VERY DENSE, SE COMPLES TO 4", SEPLEME, AT 2-0' THE TO BOOKS:				
								SAND/SILTY SAND: GREY, MOIST, VERY DENSE, COMPSE GRAINED SAND, TEMUSAL AT 5-0".				
		1_			97							
								SME: Two-grey, moisy to day, dense, SX confles to $\mathbf{k}^{*},$ measure, at 3.5'.				
		٠			97_	9_	96P					
	SW/598							SME: TAM-RAGIN, MOIST, VERY DENSE, REPUSAL AT 11-5'-				
	4-1.1	1_			91_	11_	51 •					
		<u>s</u> _			95	9_	76#	deputat at [4.5" rule injeriors.				
		2			91	_1	76R	Remarks at 17-5" aut to moks-				
9.5						9		SAFE: SAM, MOIST, COMISE GRAINED SAND.				
11-0							129	SILTY SWID: RADIN, MEY, COMMISE, GRAZINED SWID, REFUSAL AT 20.5° , WATER AT 21.0°				
2.5	S 1				87_	<u>25.</u>						
5.0	\$				91	٠	9	PROPERTY SAITS: SHOWN, NET, COMPAR GRAZINET SAID, REPUSAL AT 25-11 DUE TO LARGE MOCK.				

TH83-1308

TH83-1	308		SI	TA 854+	00 R			Q. 223±
DEPTH	F06	МС	ц	Pį	4	-200	N	DESCRIPTION
3.0	SH/SH	8		•	80	5	33 98	GRAVELLY SAND/SILTY GRAVELLY SAND CLARSE GRAINED SAND, 5 PERCENT CO REFUSAL AT 2-5 FEET DUE TO ROOKS-
2.11							3 4	SAPE: TAN-BROWN, FINE GRAINED SA
6.0	9 1 			-	84	, 	22	
	29	4			96	2		SMD: TAN-BROWN, MOIST, MEDIUM TO SAND-
8.5			*****				24	SILTY SMITH: TAN-BROWN, MOIST, MEI GRAINED SAND, WIRE DENRIS AT 9-8 H
		1		₩.	_92	15_	15	SME: BARK BROWN, MOIST, MEDIUM
	SPI							GRAINED SAND-
		27		۳	99	35	28	
18-0	···-							SMIDY GRAVEL/SILTY SANDY GRAVEL:
20.5	5P/9N	6		₩	5?	5	15	GRAINED SAID
0.5 (21.0								GRAVELLY SAMD: REGAL, MET, COARS TO A INCHES, NO SOT AT 23-0 FEET 21-0 FEET, ADDING REVERT AT 21-0
	39				59	7		
27Q		-						NO SPI AT 26-0 FEET DUE TO ROOKS
								SAMDY GRAVEL: BROWN, NET, COMPSE TO B INCHES, NO SPT AT 29-0 PEET
	G o				49	4		No SPT at 32-0 FEET DUE TO ROCHS
16-0	· 							No 97 at 75-0 DUF to 900-
	6¥				43	3		MO SPT AT 33.7 THE TH MOCK.
0.0								

ALUE ENGINEERING PAYS

TH83-1308

	٠,	TA 954+	an R		_	EL. 2232
	ш.	Pl	4	-z00		DESCRIPTION
- }-		Ψ	80	5	33	GRALTLY SAMD/SILTY GRAVELLY SAMD: Brown, MOIST, DENSE, COMPSE, DRAINED SAMD, 5 PERCENT CORREST TO 4 INCHES, REPUSAL AT 2.5 PEET DIE TO ROCKS.
<u> </u>			94	,	> *	SAME: TAN-BROWN, FINE GRAINED SAND, MEDIUM DENSE-
- -					32	SAID: TAN-BROWN, HOIST, MEDIUM DENSE, COARSE GRAINED SAID:
*			96		74	CTUTY CHATA. THE BOOKS, MOIST, METILIN TRASS. COMPSE
_						GRAINED SAND, WIRE DEPRIS AT 9.0 PEET.
-		<u> </u>	_ \$2_	15_	15	SAFE - DARK BROWN, MOIST, MEDIUM DENSE, CONESIVE, FINE GRAINED SAND.
27		₩°	99	3 5	79	
 6			5?	 5		SMITY GRAVEL/STUTY SAMBY PRAYEL: TAM-MOUND, NET, COARSE
					15	GRAFLEY SAME: BROWN, MET, COMPSE GRAINED SAND, COMMLES DO LINNES, NO STAT 27-70 FEBT THE TO ROCKS, INVER AT 21. FEST, ADDING REVENT AT 21.0 FEBT.
			59	?		
						10 SET AT 25-0 FEET QUE TO ROOKS-
						JANY (PAYEL - BOOM, MET, COMESS SPAINED SMET, COMBLES TO A INCHES, NO SPT AT 29-0 FEET DUE TO ROCKS.
			49	ù		No GPT AT 32.0 PRET DUE TO MODES.
						to the act 15.0 pur to 400k -
			43	3		™o pat at ₹3.1 hue πο MOCk-

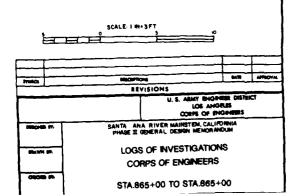
INVERT TT84-1372 STA 854+00 C EL . 206± DEPTH LOG MC LL P1 -4 -200 M DESCRIPTION SAND: MULTICOLORED, LODSE, COARSE GRAINED SAND, FBH GRAVEL GRAVEL TO 1/2 INCHES-89 1 3.0 SILTY SAND: LIGHT BROWN, MOIST, LOOSE, FINE TO CHARSE GRAINED SAND. **₩** 97 14 GRAVELLY SAND/SILTY GRAVELLY SAND: MULTICOLORED, MOIST TO WET, LOOSE, COARSE GRAINED SAND, GRAVEL TO I-1/7 INCHES. MP 95 SW/SH SMIT/SILTY SAMT: SAME, LIGHT GREY, SLIGHT CONESION, FINE GRAINED SAMD. 14-0 SP/SM MP 98 __6_ GRAWPLY SAMD/SILTY GRAVELLY SAMD. MULTICOLORED, MOIST TO MET, LOOSE, COARSE GRAINED SAMD, GRAVEL TO 1-1/2 INCHES-NP 74 5 SW/SM

NOTES.

I SEE PLATE IS FOR LOCATION OF TEST HOLES AND TEST TRENCHES

17.0

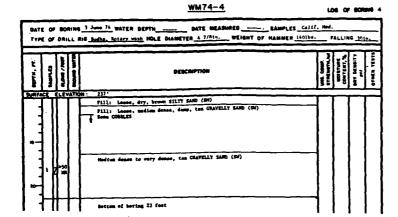
- 2 SEE PLATE OA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
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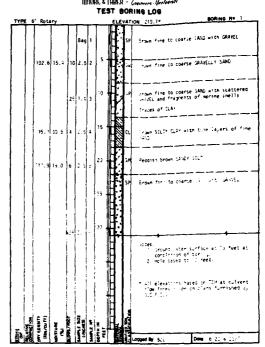


VALUE ENGINEERING

MT70-i

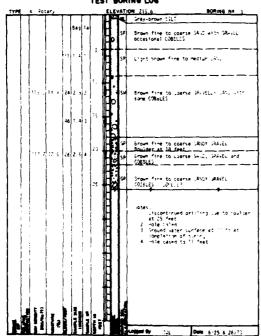
MARRE & TARER - Commone Gordons





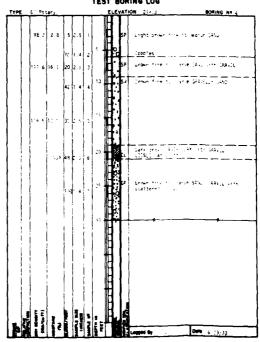
MT70-3

MINNAG & TARGA . Laguerore Garlagione TEST BORING LOG



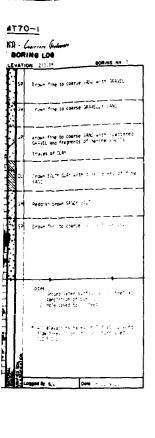
MT70-4

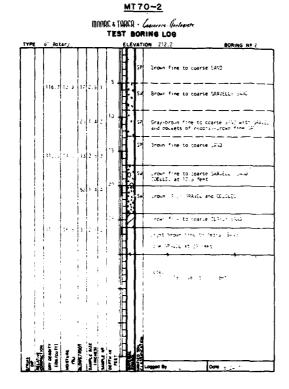
MODRE & TARER . Garages Gertine TEST BORING LOG



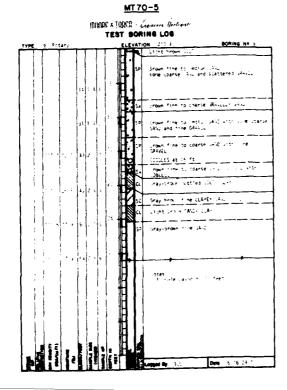
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ALUE ENGINEERING PAYS



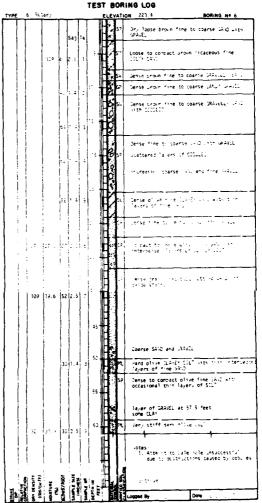


06 come to loanne 40 cm pays. energy to livering the large of the



MT 70-6

HINDRE & TARER . Gamers Gertionste TEST BORING LOG ELEVATION 227.4



NOTES:

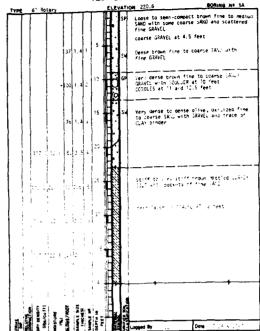
- I. SEE PLATE 13 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

SYMBOL	SECUPIONS	BAR	MPROVAL							
	REVISIO	ONS								
		U. S. ARMY ENGINEER DISTRIC LOS ANGELES CORPS OF ENGINEERS	T							
DREG-49 91,	SANTA ANA RI	Santa ana river mainstem california Phase II general design memorandum								
SEAWN SY.	LOGS OF	LOGS OF INVESTIGATION								
COSCUE IN	BY OTHERS									
	STA.905+00 TO STA.845+00									
BURNINTED BY:	DATE APPROVED.	SPEC. NO. DACWOFB	314021							

VALUE ENGINEERING PA

MT70-6A

MORRE & TORER . Conneces Gelauste
TEST BORING LOS

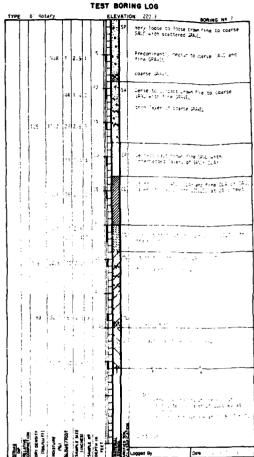


WA 69-I

Ditt fig Rotary Wash	NJ. E	LEVELIDA	457.2		16611	2 81	_	c. <u>c</u>		_
(Alumbriff Berin See Notes	MOLE B	1313001	6.1	nch	BATS	97.1			/3/6	
SOIL DESCOI	711 94						Г	P	UI.	4
SESCULATION AND REGISES	(81.00	1011111E	MISTURE CONTIST		84778	1	ş	5	i	
Fine SAMP with 6 Inch SILT	Ten	Met	Looss	87	_	Ė	Γ			
			H Dense							
CLAY lenses	জ	}	1	ļ	,	ļ		T		
Sandy GRAVEL	97	Vot	V Dense		10.		Ì			
with veriable size cebbles throughout								卢		100
f inch less of SAND w/lerge cobbles Fine to Carron SAND	Z-E-		<u> </u>	_	13	1		L]	
Sandy GRATEL	Oy Bro Oy Bro	We t	V Dras	-	ţ]		F	}	100
with some cobbins		İ			10	1	Ì	-		100
BOTTOM OF NOTE AT 24 PERT MOTTES: 1) Coving of Boring walls curre with see of extra likel dril 1) Mile net builed to determine groundwater level; 3) Mile terminated due to sever drilling conditions, counting size programe. Hony cabiles and some bouldness.	070				25					
TA WOLF Sents Am Miver L		<u> </u>	## 1 E E	110,00		1.	L	Ч		11.6
Photogram County, Calif		730	147 60	991			111	_		18

MT70-7

MININE & TABER . Contineers declearste





MT64-II

yp^	10" 640	•!		r	Top	, Ho	e Ei	%, U. ≥90.71 BORING NO. 17 evation 200.16 Completed - 2-11/15
205					. C		-	Street tity, tong with laters of street v.a. and clayer thou. Reddishehren fine to coarse rank with sandy clay leases and stattered gravel.
195		- ;			, (-	êtoer sandy clay.
î.					١.			Reddisn-prown fine to course sand.
in like	-	-	-		, (Gray medium to fire sand.
: }				¥ _	٠ (drom medium to fine same.
s ₁₂ :								NOTES: Foring located on fairly steet ramp coming off pouth bark super.: 75 set from top of bank. The steet of the steet of the steet of the steet of the steet of the steet of the steet of the steet of the steet of the steet of the steet of the steet of steet of steet of steet of steet of the steet of steet of steet of steet of steet of the steet of steet of the stee
	Dry density (25s qu.ft)	17.40m	Stand Terretophyna Colemny Tett	Sompre act	Scenpte No.		Unified soul	

ALUE ENGINEERING PAYS

MT70-9 MARRE & TARER - Coursers Genteurs TEST BORING LOG ELEVATION 223,7 BORING N Brown medium to coarse SAiO cose provin fine to coarse area applica-Dark gray to brown SILT edium to poamle paul and Brown medium to coarse SAND with GRAVEL with thin layers of fine SALD t under file to lastis Gray-prown SANDY CLAY with scattered Grown fine to coarse SANO with fine GPAVEL coarse GPAVEL between 15.5 and 16.5 feet | s. | · 2 | 4 | 22 Coarse SPAVEL countries at laste sery of the last laste. Fromh fin - to coarse GRAVELLE SAND with scattered - 320223 and thre was the Presummants, Occided educen 45 and 20 ft Brown fine to overse unit loanse whereboard locality at at feet otevictic dales follo fretvinomever, 100 ground Latter Lyffele excuent as Lenstein Kuch Lyffel 1 mote La en to 1 mes 1 The state of the s to surrought of the Dong MT64-11 MT64-12 NOTES: G. L. 218.50 Top Hole Plevation 273.2 Top Hole Stevation (b) Type 6" Dietet Jager Brose gravelly slith same with some tourse gravel. are to a result broom of sindy class 220 sendy clay levent and scattered gravel. Brown milto mand and grayel with few milty clay lenges. brown clean fine to coarse sand with some gravel. promining com-Tedersa, town fine to cheese sand. From sang clay. Stay made in the game. Brow fine to course ment with course gravel.

MT70-8

HINDAR & TAARA . Commerce Goodcarts TEST BORING LOG EVATION 224.8 Loose brown medium to coarse sAND with fine GRAVEL thin layers of SIL? Brown fine to coarse sAIO with interbedded layers of CLAYER SAIO occasional trin layer of TVAVEL grown fine to sparse SRAVILLE Selv Brown time to heature LAND Tan very fine SILTY SAID Gray-timbur fine skill with SkillsTG/E fragment Design 1972 1985 otes Tomble reservity 11 met

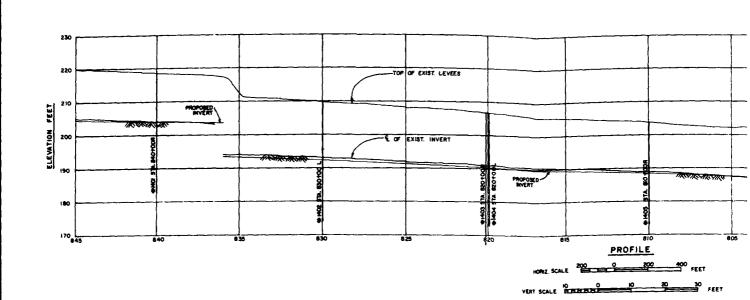
Milli-per a craimed on fairly steem mamp coming iff could have surgers 25 feet formed to be a. Commission of bear and a servation in although three was recuting water 1.30 feet at almost on 20%. Fact to megrate full rate with no significant cave.

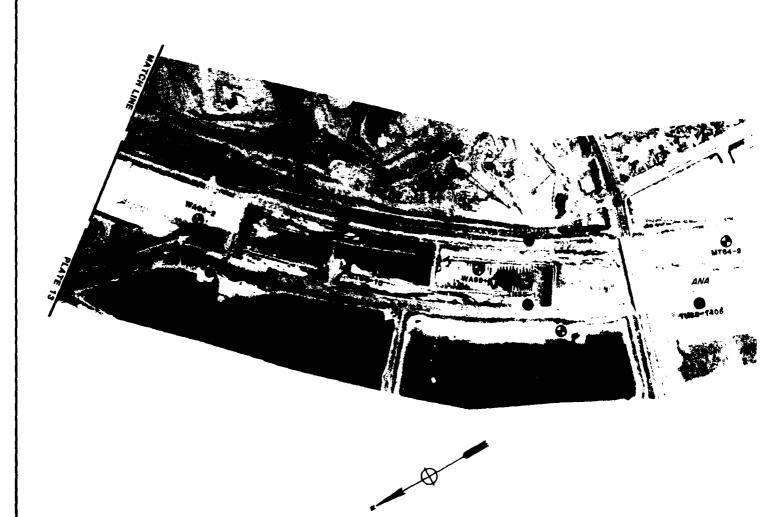
Earling incited in getting remisoring of Dearling increased in microckethod in migrous 30% for top of books. The promotion of the promotion was undergeters, in the books although their books promotion where 20 feet amount on 10 feet before books and the feet before the state of the time. The time of time of the time of the time of the time of the time of the time of the time of the time of the time of the time of the time of time of the time of the time of time of the time of time

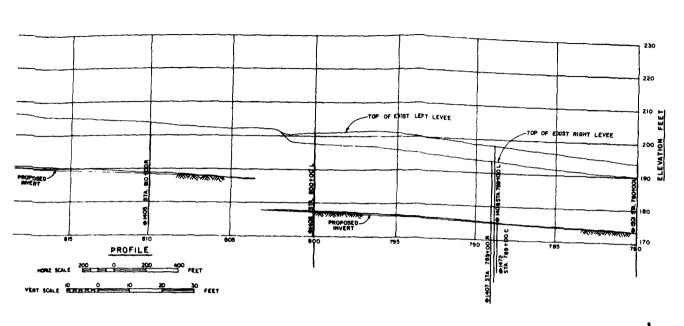
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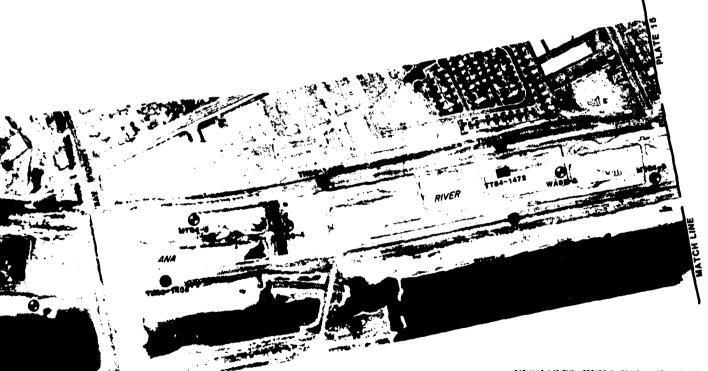
-F		= $=$ $=$								
SAME	DESCRIPTIONS	DATE	APPROVAL							
	REVISIONS									
		A DA BAGAGES OF VACGORES	ict							
concrete Pri	SANTA ANA RIVER MAINSTE PHASE II GENERAL DESIGN I	Ana River Manstem, California Be II General Design Memorandum								
STATES ST.	LOGS OF INVESTI	BATION								
OFFICE PA	BY OTHERS	BY OTHERS								
	STA.905+00 TO STA.645+00									

VALUE ENGINEERING PAY









- I. SEE PLATE 8 FOR LEGEND AND GENERAL NOTES
- 2 SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

STANCE.	740700		-	1
,,,,,		ISIONS	1 244	
		U. S. ABMY THIGH LOS AND CORPS OF EN	A.B	CT
OEMONED EV.		RIVER MAINSTEM, CALIF NERAL DESIGN MEMORAN		
SEA VINE SV	PL	AN AND PROFILE		
GROSS SI	STA.845	5+00 TO STA.780+	00	
SUBMITTED ST:	DATE	SPEC. NO. BACWOP		T

TH 83-1401

TH83-1	401		S	TA 840	+00 R			EL • 219±					
DEPTH	L06	MC	ŧL.	PŢ	4	-200	N	RESCRIPTION					
2-5	591	7		NP	81	18		SILTY GRAVELLY SAND, BROWN, MOIST, DENSE, MEDIUM GRAINED SAND, REPUSAL AT 2-5 PEET.					
2.2	SP/SM			<u> </u>	92		2 3 R	SAND/SILTY SAND: Brown-tam, Moist, Medium Grained Sand, FEM GRAVEL, REFUSAL AT 5-5 FEET DUE TO ROCKS-					
7.0	377381	,			32		21R						
8.5	GM/GC	9	23	6	57	16		SILTY SANDY GRAVEL/CLAYEY SANDY GRAVEL: GREY-TAN, DENSE, COMBLES TO 6°, NO SPT AT 8.0' JUNE TO BOOKS.					
		6		Ψ	80	10		GRAVELLY SAND/SILTY GRAVELLY SAND: GREY-TAM, DENSE, CORRLES TO 5 INCHES, NO SPY AT 11:0 FEET DUE TO ROOKS.					
	SH/SM	6		ПР	78	,		SAME: TAN-GREYISH BROWN, MOIST, MEDIUM GRAIMED SAMD, FBH GRAVIEL.					
		5		₽	90	8	Ą	SAME: MEDIUM DENSE, REPUSAL AT 17-0 FEET DUE TO ROOKS-					
1.0	···						24						
5-û	2h			幣	89	14		SILTY SAMD - GREY, MOIST, ORGANIC SMELL.					
		<u> 5</u>		¥ρ	87		40	SAND/SILTY SAND: TAN-BRN, MOIST, MED, TO COARSE GRND- SND-					
	SH/SM	, ह		•	8 9	ŧ	30	SAPE: Medium dense to dense-					
								SAME: Dense					
0.0							47	SAMD/SILTY SAMD: TAN-BROWN, MOIST, EDIUM TO COARSE GRAINED SAMD.					
	92/5#	8		₽	98	6	46						

TH 84-1402

EL - 210:				•00 L	A 830	S1		¥02	THB4-14
DESCRIPTI		H	-200	-4	PI	Щ	MC	L06	DEPTH
SAND/SILTY SAND: LIGHT BROWN, SOME CLUMPS OF COMESIVE CLAYEY	SAK		12	94	MР		12	SH/SH	7.0
SAMD: LIGHT BROWN, MOIST, FIN	SAN	40					_		3.0
			3	34			3		
		28							
SAME: FEW GRAVEL TO 1/2 INCH	SAM	8							
			3	93			4	SP	
		26							
SAME: FEW GRAVEL TO 1 INCH-	SAYE	39	2	35	-		;		
		12	2	88		-	_		1.0
SAMPY STLT/SAMPY CLAY TARE TO COMESTIVE, FINE GRAINED SAME.		77	65	39	5	79		۴.	-
SAMOY GRANEL/SELTY SAMOY PRIVE TO MEDIUM DENSE, FINE TO COMPT 3 INDRES, COBBLES TO 5 INCHES, COARSE GRANEL, NO SPT at 27.5	SAM!	R	5	39	₩P			as ige	4-1
									<u>3.3</u>
SAMDY GRAVEL: DARK BROWN, 401 FINE TO COARSE SRAINED SAMD > TO 5 INCHES, NO SPT AT 79.5 SE	SANG FINE TO		4	36				٠.٤	
GRAVELLY SAND/STLTY GRAVES YOU LOOSE TO MEDICAL DENSE, FINE YO	GRAY		·	 57				12-54	3.1

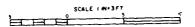
VALUE ENGINEERING PAYS

TH 84-1402

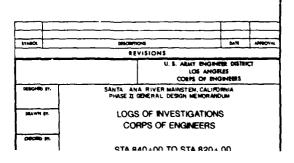
12		2.	4 3304	-00 L			EL - 2102
1.06	MC	ш	PI	-4	-200	4	Description
EN/SH	12		¥		12		SARTYSILTY SAMD: LIGHT BROWN, MOIST, FIME GRAINED SAMD, SOME CLUMPS OF COMESIVE CLAYEY SILT:
	3					4 S	SMIT: LIGHT BROWN. MOIST, FINE TO COARSE GRAINED SAND, FEN OR APEL.
						29	
ţ	4			1!		3	SAME - FEN GRAVEL TO 1/2 INCH.
•						25	
	3			•	,	19	SAME FEW GRAPEL TO LINON.
						13	
	÷	, i			<u>-</u>	٠.	CANNY CTITICANNY (LEV. TARK BRIMM, MOIST, VERY STIFF, COMESIVE, STAME GRAINED SMED.
2.64			*	**		3	SAMPL PANEL/SI, TO SAMPL SPANEL. THAN BROWN, HOLST, LOOSE TO HEDITH DENSE, FIRE TO COMMISS SHALMED SAMD, GRAVEL TO 3 LINCHES, GERISAL AT 24-5 FEET DUE TO COMMISS SPANEL, NO SPI AT 27-5 FEET DUE TO ROOKS.
٠							TARTY TRAFF. THAN BROWN, MISST, LODGE TO MEDIUM DENGE, FINE TO COMPSE TRAINED SIND, GRANGE TO \$ INCHES, COMBLES TO MOVER OF \$ 7.5 FEET DUE TO COMBLES.
							TO CHARMAN HAS SPT AT 19.5 REET DIE TO COMMUNES. TRUST Y SAMONSTEIN GRAWELLY SAMON DARK MENNAL HOLST.
ः द्व			*				LONGE TO MEDI A DENSE, EINE TO COMPSE BANKED SAND, SANGE, TO STINCHES, COMMES TO STINCHES.

TH 83 1404

THB3-14	104		s	TA 820	+00 R			EL - 2072
DEPTH	L06	NC.	LL	ρį	4	-200	H	DESCRIPTION
1.5		_10_		P	89	_14_	37	SILTY SAID: BROWN, MOIST, DENSE, FINE TO COMPSE GRAINED SAID, FEN GRAVELS, FIRST 6 INCHES ORGANICS.
3.0	32/24			MP	93	6_	22	SAND/SILTY SAND: TAN-BROWN, MOIST, MEDIUM DENSE, FINE TO MEDIUM GRAINED SAND, FEN GRAVEL.
								SAND: TAN-BROWN, MOIST, MEDIUM DENSE, MEDIUM TO COARSE GRAINED SAND, FEW GRAMEL.
	SP	8			91	3	19	SHAPE JAMES, FEW SHAPES.
		6			95	3	-	
9.0							22	
	SP/SH	6		No	83	5		SAMD/SILTY SAMD: TAN-BROWN, MOIST, MEDIUM DEMSE, MEDIUM TO COARSE GRAINED SAMD.
12-0							18	
13-5	20	6			69	2_		GRAVELLY SAMD: BROWN, MOIST, MEDIUM DENSE, COARSE GRAINED SAMD, FEW CORRLES TO 4 INCHES.
15-0	SW/SM	. 6		. 192	72	_5_		GRAVELLY SAND/SILTY GRAVELLY SAND: BROWN, MOIST, LOOSE, COMMISE GRAINED, SAND, FBH COMMISES TO 9 INCHES.
		20	_25	5	99	59_		SANDY SILT/SANDY CLAY: TAN-BROWN, MOIST, MEDIUM STIFF, COMESIVE, FINE GRAINED SAND, FEN GRAINEL, ADDING MID AT
	ML/CL	24	25	5	90	53		15.0 FEET-
		24	24	5	97	55		SAFE: PEDDESH BROWN.
21.0							7	
	α		24	9	99	63		SAMDY CLAY: REDDISH BROWN, MDIST, VERY STIFF, COMESIVE, FIME GRAINED SAMD, OCCASIONAL GRAVEL.
24.0							42	
25,5	sc_	16	_27_	8_	100	43		CLAYEY SAND: REDDISH BROWN, MOIST, COMESIVE-
27.0	64/SC	_	26	7	50	15	14	SILTY SAMBY GRAVEL/CLAYEY SAMBY GRAVEL. REDDISH BROWN, MOIST, COMESIVE.
	ge.	16		ΝР	55	27		SILTY SMIDY GRAVEL: REDDISH BROWN, MOIST, CONESIVE, FINE GRAINED SAND-
31.0		12		₩	59	29	Q	SAME: "EDILM TO COARSE GRAINED SAND, TORBLES TO 4 INCHES. REFUSAL AT 29.7 FEET.
	SW/GM			NC.	47	6	R	SMMY GRAVEL/SILTY SMMY GRAVEL: PENDISH MODH, WET, FIME TO OTHERSE GRAINET SAMD, OCHASIONAL COMMLES, REPISAL AT 37-0 FEET-



- 1 SEE PLATE 14 FOR LOCATION OF TEST HOLES AND TEST
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED ,H EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT"



TH83-I403

THB3-1	403			STA 82	0+00 L			EL- 207\$
DEPTH	T06	MC	ш	PI	4	-200	N	Description
2-0	SPI	8		167	59	17	_	SILTY GRAVELLY SAND: BROWN, MOIST, TOP 1-5 PEET, ASPI MIXED IN SOIL-
		3		ıφ	91	6	50R	SMID/SILTY SMIT: TAN-BROWN, MOIST, DENSE, MEDIUM GRAI SMID, FEW GRAVEL, MERUSAL AT 2-5 FEET-
	SP/SM	3		IP.	93	6	20R	SAME: REPUSAL AT 5-5 PEET DUE TO ROOKS-
8-0	591	,		#P	88	13	198	SILTY SAND: TAN-BROWN, MOIST, DENSE, REFUSAL AT 8.0 F DUE TO ACCKS.
12-0								SAND/SILTY SAND: TAN-BROWN, MOIST, DENSE.
	SP/SM				92		39	
8-0		6		₽	91	7	46	
	SM/SM	19		IP.	91	8	~	
1.0 2.0							5	
··0	98/SH HL/QL	19	23	_ 12 _5	99 100		11	SAME: BROWN, FINE TO MEDIUM GRAINED SAMD- SAMDY SILT/SAMDY CLAY: REDDISH BROWN, MOIST, LOOSE SLIGHT CONESION.
							**	SANDY CLAY: REDIDISH BROWN, MDIST, FIRM, SLIGHT CONESIO
	α	17	33	17	100	71	15	
3.0	_	ष	29	10	100	77		
2:0	5C	5	26	3	53	n		Q.AYEY SAMPY GRAVEL: PEDDISH-RROWN, MOIST, 9.16HT COMESION, COMBLES TO 5 INCMES, NO SPT AT 29.0 PEET DUF ROCKS.
	GP/GM	6		Ψ	45	5		SMOY GRAVEL/SILTY SMOY GRAVEL. ROOM, MOIST, MEDIUM ODAYSE GRAINED SMO. COMBLES TO 6 INCRES.
i-U								GRAVELLY SAND/SILTY GRAVELLY SAND: BROWN, MOIST, MEDIUM
	26/24	5		MD.	61	7		TO COARSE GRAINED SAND, COMMLES TO 6 INCHES.
3.9								

TH83-1405

7183-1	405		s	ia sic	H00 K			EL . 2041
DEPTH	L06	MC	ш	PĮ	4	-200	11	DESCRIPTION
1.5	_9	_ 9			96			SAND: GREY, HOIST, FRI GRAVEL
2.0	0	13	- 29	1	_00°			SAMEY CLAY: RETORISH MICH. HO SAMEYSILIY SAME: GREYISH TAN-I
3.0	SW/SM	٩.		-₽	_99_	11_	2字	HES TO S INCHES, MERICAL AT Z
	34	9	20	4	72	18		SILTY GRAVELLY SAID: BROWN, PO GRAINED SAID, FEW GRAVEL-
5.5							44	
<i>1:</i> Q_	SP/SH	4			93	5_	•	SAME/SILTY SAMD: BROWN, MOIST, GRAINED SAMD, FEM GRAVEL.
		و		IIP	91_	15_	168	STLTY SAND: BROWN, MOIST, SLIS GRAINED SAND, FEW GRAVEL, REPA
	SP!	12			81	20	104	GRAVELLY SILTY SAME: SAME, DAY 0000R-
						_		SILTY SAND: SAME, BADAN, REFUE
13.0		19		Mb.	92	7	16R	
14.D	SW/SM	- 6		10	96	8		SAND/SILTY SAND: TAN-BROWN, DA
15.0				-			27R	SILTY SAID: TAN-BROWN, DATE,
	571	3		ДP	9.7	33	27.	GRAVEL, REFUSAL AT 14.5 FEET.
7.0								
18.0	ZM/24			_12	95	9_	23	SAND/SILTY SAND: GREY, MOIST.
		15						CLAYEY GRAVEL: REDDISH BROWN. MEDIUM DENSE-
	60	17	32	13	57	45	27	
22-0							23	
3.0	20	. 5		- 8	69.	22		GRAVEULY CLAYEY SAMD: REDDISH MEDIUM GRAINED SAMD:
								SAMOY GRAVEL/STLTY SAMOY GRAVE
	6P/6M	5		₩	43	9		FINE TO MEDIUM GRAINED SAND, RI ROOKS-
7.0							208	
		2				_	2.00	STUTY SAND: REDDISH DROWN, HO
	SM			40	199	14		SAND, FEN COBBLES TO 5 INCHES, GRAVEL-
	-	1		•	• • • •	• •		
		-						SAVE: MOIST TO HET, CAVING AT
2.0								

VALUE ENGINEERING PAYS

TH83-1405

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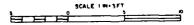
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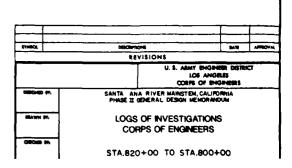
	\$1	A 810	100 R			EL - 2042
MC.	ц	PI	4	-290	N	DESCRIPTION
_						SAND: GREY, HOIST, FEN GRAVEL ASPHALT MIXED WITH SAMPLE-
	79	_	-1 3	<u> 59</u>		SAND/SILTY SAND: GREYISH TAN-BROWN, MOIST, DENSE, 54 COB-
9		_P_	99	11_	238	MES TO 4 INCHES, REPUSAL AT 2-5 FRET-
9	20	4	72	18		STLTY GRAVELLY SAID: BROWN, HOIST, DENSE, FINE TO MEDIUM GRAINED SAID, FEN GRAVEL.
4		P			44	SAND/SILTY SAND: BROWN, MOIST, DENSE, FINE TO MEDIUM GRAINED SAND, FEN GRAVEL.
9		IP.	_91_	16_	100	SILTY SAND: BROWN, MOIST, SLIGHT COMESION, FINE TO MEDIUM GRAINED SAND, FEW GRAMEL, REPUSAL AT 8.5' DUE TO ROCKS-
12_		165	81	_20_	16R	SRAMELLY SILTY SAND: SAME, DAMA GREY TO GREY, ORGANIC GROOT-
10		100	92	,	15R	SILTY SAMD: SAME, BROWN, REPUSAL AT 11-5 FEET-
6		P	96	8_		SAND/SILTY SAND: TAN-BROWN, DAMP, MEDIUM DENSE-
8	_	ıφ	g;	13	2.78	SILTY SMID: TAN-BROWN, DAMP, MEDIUM DENSE, OCCASIONAL GRAVEL, REPUSAL AT 14-5 FEET, MATER AT 15-0 PEET.
12		P	95		25	SMID/SILTY SAND: GREY, HOLST, FINE TO MED- GRAINED SAND-
15						(LAYEY GRAVEL: REDDISH BROWN, MOIST, SLIGHT CONESION, MEDIUM DENSE.
17	32	13	5*	45	21	
 5	23		59	22		GRAVELLY CLAVEY SAND: REMOISH BROWN, MOISY, FINE TO
5		Ψ	ų3	9		SANTY SRAVEL/SILTY SANDY GRAVEL: REDDISH BROWN, MOIST, FINE TO MEDIUM GRAINED SAND, REFUSAL AT 25-5 FEET DUE TO GROCK-
					209	
1						SILTY SAMD: REDDISH BROWN, MOIST, FINE TO MEDIUM GRAINED SAMO, FEW CORBLES TO 6 INCHES, NO SPT AT 29 FEET DUE TO GRAVEL.
- ģ-		*	121	;•		SAME: Moist to wet, caving at 32.0 PEET-

TH83-1406

							1710	~~~~				
TH83-14	06		S7	7A 800	•00 L		EL. 201.t					
DEPTH	L06	MC	ц	Pl	4	-200	R	DESCRIPTION				
1.5	94	3		NP_	91		23	SAND: BROWN, MOIST, MEDIUM TO DEMSE, FINE TO MEDIUM GRAINED SAND:				
		3_		IP.	98	6_	16	SAND/SILTY SAND: BROWN, MOIST, FIME TO MEDIUM GRAINED SAND, FEM GRAMEL-				
							18					
	SW/SM	.9.		<u> 19</u>	97	5_	22					
	S#/S/1	5_		NP	97	6_	14					
		5		MP.	98	5	12	SAME: TAM, MEDIUM TO COMPSE GRAIMED SAMO, CAVING AT				
18.0		4		w.	97	5	17	SME: TAM, MEDIUM TO COARSE GRAINED SAMD, CAVING AT 18.0 PRET, ADDING REVENT AT 18.0 PRET.				
	SP				93	4		SAMD: TAN, MOIST, MEDIUM TO COARSE GRAINED SAMD-				
21.0							18	SILTY SAND: RROWN, MOIST, METHUM GRAINED SAND-				
	SH	19		_R_	100		36					
27-0		17		₩	99	31	35					
28.5	211/21			₩2.	100	9.		SAND/SILTY SAND: BROWN, WET, MED- TO COARSE GRAINED SAN				
		25	. 39	15	100	42	25	CLAYEY SAND: BROWN, WET, CONESIVE, FINE TO MEDIUM GRAIN SAND-				
33.0	sc		15	39	100	49	32					
35.0	SP/SPI			WP.	190	9	-	SAND/SILTY SANT: BROWN-TAN, WET, HEDLUM TO COAPSE GRAIN SAND-				
37.0	Ħ.			₩	100	60		SILT: BROWN, WET, STIFF, MEDIUM SPAINED SAND-				
	a.	25	36	16	100	92		CLAY: PEDDISH BROWN, MOIST, FINE GRAINED SAND-				
90.0							12					



- 1 SEE PLATE 14 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



TH83-1407

THB3-1	407			STA 7	39+00 R			EL- 1932
DEPTH	٤06	MC	u	. Р	1 -4	-200	H	DESCRIPTION
3.0	SM/SM	<u> </u>		98	79	9		SAMD/SILTY SAMD: BROWN, MOIST, MEDIUM GRAINED SAMD, OCC. STOWAL GRAPEL, ASPHALT TO 2.5 FRET, MERISAL AT 2.5 FRET DUE TO MOCKS:
	SPI	9		16	99	18	•	SILTY SANTI: BROWN, MOIST, DENSE, FINE TO MEDIUM GRAINED SAND-
6.0							_ 60	SAND/SILTY SAND: BROWN, MOIST, VERY DENSE, FINE TO MEDILI GRAINED SAND.
		2					56	
								SME: Occasional gravel, FeW combles to 4 inches, No SPT at 11.0 FeET DUE TO ROOKS-
	SW/SM	_6_		160	95	13		SAME: MIRE DEBRIS, NO SPT AT 14-0 FEET DUE TO ROOKS-
		<u>6</u>						
		7						SAME: NEDIUM GRAINED SAMO.
8.0							41	
	99	16			99	2		SATD: BROWN-TAN, MOIST TO NET, DENSE, MEDIUM TO COARSE GRAINED SAND, OCCASIONAL GRAVEL, FEM CORRLES TO 4 INCHES.
2.0							32	
1.5	3P/5M	13		ΝP	98	5	39	SAND/SILTY SAND: BROWN-TAN, MOIST TO NET, DENSE, MEDIUM TO COARSE GRAINED SAND, OCCASIONAL GRAVEL.
7.0	99				95	2	84	SMIT: GREY, NET, DENSE, COMPSE GRAINED SAND-
	SM	32		Ψ	lw	34	44	STLTY SAND: PROMIN, MET. SLIGHT CONESION. MEDIUM TO COMPSE GRAINED SAND.
1.1							17	
								CLAY: RECHI, MET, STIFF, FINE TO MED. GRAINED SAND.
		57_ 52	41	15	190	85	17	
	دد						13	
								SANDY FLAY: SANE & MOVE, REDDISH BROWN-
		18_	28	12	100	77	21	
.5								
.0.	ዎ					_		CREATE Y CAND: PEODISH PROMI, NET, 30 PERCENT GRAVEL.

TT84-1472

TT 84 -14	אַנ		s	TA 789	900 C			EL- 1752
KTGBØ	106	МС	ш	PÍ	-4	-200	•	DESCRIPTION
								SAND: MALTICOLORED, MOTST, LONSE, FI
	39				97	0		
6-0 7-0	•		_	•	98	50		SAMITY SILT: LIGHT GREY, MOIST FINE O
								GRAVELLY SAMD: MULTICOLORED, MOIST, 1 INCH, SOME SILT-
	3º				84	2		
					94	3		SAND: SANE AS ABOVE, FEN GRAVEL TO ?
M 14-0								
15-0			63	30	100	84		SAMPY SILT: DARK MONI, HET-

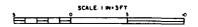
VALUE ENGINEERING PAYS

TT84-1472

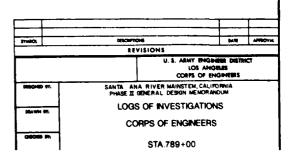
	st	4 789·	08 C			EL- 175±
-	LL	Pī	4	-200	1	DESCRIPTION
						SAMD: MULTICOLORED, MOIST, LOOSE, FEH GRAVEL TO 2 INCHES-
			37	9		
F	. <u>-</u>	•	90	 		SAMEY STUT: LIGHT GREY, WAST FAME GRAINED.
Ρ.						GRAFELLY SAMD: MULTICOLORED, MOIST, LOOSE, FEN GRAVEL TO 1 MCM. SOME SILT.
			84	2		
			94	3		SARE SAME AS ABOVE, FEW GRAVEL TO 3", MATER AT 14-0".
	- 63	30	100			SMANY SI.T. DARK BROWN, MET-

TH83-1408

THB3-14	108		STA 789+00 L				£L- 198x			
DEPTH	L06	MC	LL	PI	-4	-200	H	RESCRIPTION		
1.5	S P	_ 5_			97_	4	24	SAMO: PROMI, MOIST, MED- GRAINED SAMD, OCCASIONAL GRAVE		
3.0				*	<u></u>	7]	16	SILTY SMITH: BROWN-GREY, MOIST, MEDIUM GRAINED SAND-		
	29	4			99	3		SAMT: BROWN-GREY, MOIST, MEDIUM GRAIMED SAMD, NO SPT AT $5.0~{\rm FEET}$ DUE to $8~{\rm IMCM}$ conside.		
7.5		18	_		39	2		SAME: DARK BROWN, FINE TO MEDIUM GRAINED SAND-		
		<u>.</u>					25	SAMB/SILTY SAMD: BROWN-GREY, MEDIUM GRAINED SAMD-		
	5 9/SM	8		φ	99	7		SAME: FINE TO MEDIUM GRAINED SAME		
12.9							16			
	59	4			98	3		SMID: BROWN-GREY, MOIST, FINE TO MEDIUM GRAINED SAND-		
15.0							12			
		12						SAMPY SILT: BROWN, MOISY, STIFF, FINE TO MEDIUM GRAINED SAMP.		
	Ħ.	26		40	100	52	17			
21-9							23			
23.0	SH	6		10	99	14	2)	SILTY SAND: BROWN, MOIST, MEDIUM GRAIMED SAND-		
		_ <u>u</u> _			-		₹2	SAND: "ROWN, MOIST, MEDIUM GRALMED SAND-		
					99	2				
	èъ	<u>4</u> 18					?5	SAME: MET, WATER AT 29.0 FEET-		
<u>⊮ 29-3</u>										
							21	SAME - COARSE SPAINED SAME		
52-0							18	SAMITY CLAY: REDDISH-BROWN, MOIST, VERY STIFF TO HARD,		
		44	35	9	39	53	īq	SIME GRAINED SMED-		
	_	•		-			35			
	a.									
							46			
90.0										



- I SEE PLATE 14 FOR LOCATION OF TEST MOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



VALUE ENGINEERING FE75-10 WM74-2 FE75-6 LOG OF TEST HOLE LOG OF TEST HOLE MC DO 4 200 DATE OF BORING 3/531/4-76 WATER DEPTH 10 . DATE MEA MC DO 4 200 DESCRIPTION 7H-10 77-6 [SILTY SAND - Brown, damp 95 10 SAND- Brown, Fine to coarse, damp, med dense to dense, TYPE OF DRILL RIG Builts, SGERRY WASH MOLE DIAMETER 4 7/81 SAND - Brown, damp, dense, buried cable at 3. 5 115 100 10 DESCRIPTION 4 SILTY SAVO - Brn, v/moist, Soft / med. 42 109 100 50 Some gravel to 1.º Fill: Looke, dry, brown GRAVELLY SAID (SV 95 5 SAND- Brown, Moist/wet, | Monthy tan, course-erained SAME (SW) med dense, 4 100 5 - Thin lense of brown CLAY Fill: Locad, tan, MAND (SP) occasional G Severe orving Excavated 3.4-15 Loose, tem GRAVEL Soft-medium stiff, stay Silly CLAY (CL) Loose, gray SILTY SAMD (SM) Irravated 2 24 75 FE75-9 Dence to very dense, ten SAMD (SP-SH) with TH-9 SILTY SAND - LOOSE, Clamp, disturbed SAND- Brown, damp, fine to course, dense. 5 112 100 10 Hedium stiff, gray SILTY CLAY (CL) Hedium Sense, gray CLAYET SAND (SC) Discontinuous Silty layers water seeps at 3, Caving, 1 148 100 5 MICH CHANEL Dense, brown GRAVELLY SAMD (SP-9C) Dense, brown GRAVELLY SAMD (SF-SH) more moist w/ depth. 8 97 100 15 Bottom of boring 52 feet Escorated 3.4.75 WA 69-3 WA 69-2 CRIFF 4.C) ine t

HLL BIS Rotary Wash	MUC	CLEVATION	201.	7	LACOR			<u>.с.</u>	_	
Bungesiff C[Pin See Hotes	HOLE	I METER	6 Incl		SATE	9611	us	_	/69	_
SBIL BESCA	PE104					П	Г	7	7	¥
BESCRIFTING MIS REMARKS	C 95. 999	00 1 5 T 100 E	C01111	1811. 1795	DEPTH	1	ş	1	1	Estante Estante
Medium to Course SARD	Brown	Wet	Louse	22	_	i ~	1	T.	_	
	ł	ļ	H Dense			1	ļ	١.	1	}
with layers of Grovel throughout		į	Dense		,			<u>L</u>		
			V Dones		10			<u> </u>		
					15			I		
vick occasional small cobbles					20			I		
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A.S.

VALUE ENGINEERING PAYS

<u>WM74-2</u>

DATE OF BORING PARTIEST MATER DEPTH 10 . BATE MEASURED 1 Junt 24 SAMPLES PICCHOT and Calif. Not.
TYPE OF DUILL RIG 5.154 SALET VAIN MOLE DIAMETER 6. 7/Alin. WEIGHT OF MAMMER 140154. FALLING 19 OTHER 76879 DESCRIPTION Fill: Loose, dry, brown CRAVELLY SAND (SW) Hostly tan, course-grained SAMD (SM) Thin lense of brown CLAY Fill: Loud, tan, SAMD (SP) occasional GRAVEL Loose, ten GRAVEL Soft-medium stiff, gray Silty CLAY (CL) Loose, gray SILTY SAMO (SH) Jense to very dense, tam SAMD (SP-SM) with GRAVEL Hedium dense 114 Medium stiff, gray SILTY CLAY (CL) 85 Medium Jonse, gray CLAYET SAMD (SC) Dense, brown GRAVELLY SAMD (SP-SC) Dense, brown GRAVELLY SAMD (SP-SH) Bottom of boring 52 feet

WM74-3

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DESCRIPTION AND GEMBES	CREM	mi stune	comsist	101L	96918	=	Ę	-5		25
Yine to Medium (Clean) SAND	Cy Brn	Vet	Loose	SP		-	_		-	-
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- I. SEE PLATE 14 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

			
SYMBOL	DESCRIPTIONS	DAW	APPROVAL
	REVISIONS		
	U. S. ARMY EN LOS AI CORPS OF		ACT .
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BRAWN BY.	LOGS OF INVESTIGATION	ON	
	BY OTHERS		
ORCHED IN	STA.845+00 TO STA.780	+00	

WA 69-5

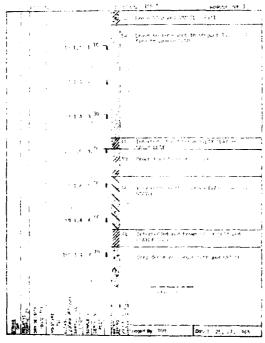
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and few boulders		-	+	\vdash	t	1	iΙ			
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MT66-3

TEST BURING LOG



MT66-3 (cont'd)

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VALUE ENGINEERING PAYS

MT66-1

TEST BORING LOG

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1.5 P.2.5 to the order SILIY CLAY

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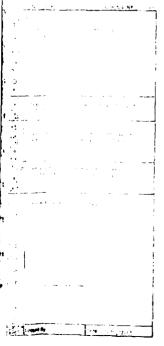
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MT66-2

TEST BORING LOG SSW Mottled brown well graded SALOD with 10 1.4 2 10 1 15.2.51 3 1991.4 a. Of tensors of fire to reduce \$500 the state of the s

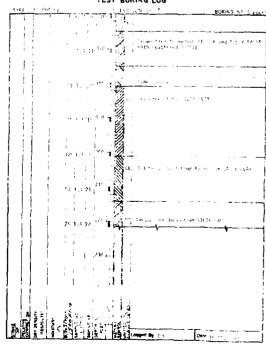
66-3 (cont'd)

T EDRING LOG



MT66-3(contd)

TEST BORING LOG



- 1. SEE PLATE 14 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS
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BYMBOL	DESCRIPTIONS	OA1	1 APPROV			
	REV!	48				
		5. ARMY ENGINEER DE LOS ANGELES CORPS OF ENGINEER				
1000-00 tr.	SANTA ANA I PHASE II GEN	RIVER MAINSTEM, CALIFORNIA ERAL DESIGN MEMORANDUM				
MPWAN 20	LOGS O	F INVESTIGATION				
-	8	Y OTHERS				
	STA.845	STA.845+00 TO STA.780+00				
Albufrito In	DATE	MSC. NO. BACWS9 B.	94071			

MT66-4

т	EST BORING LOG	BORING Nº 1
TYPE 16" Bucket	ELEVATION 193.5	
	SP Brown very fine to me	
2.4 9ulk 1	L preces or sceer and	pitce, tr trit
2.9 Gulk 2	SP Mottled trown well gr	aded SAMD with scatter
2.7 Bulk 3	1004 12" face sand feet	
	SH Cray-brown CLAYEY SIL	
124.0 5.7 8 ,2.515	SF Brown very fine to fi	
3.5 Hulk 6	SW Mottled brown well gr	aded SAND
108.1 3.1 4 2.5 8	ML: Gray-brown SILT	
98.2 12.0 2,2.5,10:	CL Gray-brown SILTY CLAY	
83.6.37.4 ?12.5.11	CL Reddish-brown SILTY C	LAY with
115.6 16.6 2 2.5 12	133	
5.3 Bull 13	SC - SH YELT LES HE THE WELL SE	PREES SAUD with about
5,3 Bulk 13,	Notes: 1. Minor cavir 2. Water not e 3. Hole backfi	q throughout ncountered
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MT66-17

TYPE 15" Pucies SELEVATION 197 SOURCE CONTROL 197 SOURCE CONTRO			
SM Reddish troom file to charse (RALC) : 1 SM Prown file to charse SANO Small Reddish troom file to charse SANO No water and size carries shaw 31			
3 2.2 7 5 Prown fine to charse GAALCY (Fill) Rowater and 2 for cartic strips 31	TYPE 15" Pucher	ELEVATION 187 BO	RING Nº
to pater and see carro selon 3.		3 2.2 1 5 7	GRAVET +
to water and a remeaning tribum 31			
The state of the s		ho water and size carries in	ov ?*
	Par Of an Office of the Office	The state of the s	

MT64-9

Турч 1/."	Buck	t			Top	1101	e E	t. L. 189.9 BORING NO. 9 levation 192.9 Completed ~ 2-17-64
145 LEO (6175 - 177)	Birch							
	Dry density (Ds. ce.ft)	Month ore	Srond Payersphon (5'0ms//both	Somble 1110	Somple Nº		closs from	

MT64-10

175	-	Poly just bound in	,		seem motion to fine said at! I were of states that the said at the
Deprin on teer of broad transfer			5 (term. Dine to course sand with sold to
195			, 4		Same as three vital lenger of elite variant clare sand
201			2		Clean fine to coarse sand with some pro

LUE ENGINEERING PAYS

MT66-17

	TES1	BORING LOG	
" Party		LEVATION F	BORING Nº 17
		So record troub face 1937	to coarse GRAVELLY SAMD
		July tower time to chan	se 5/MD)
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		to water and size :	cavino 301gm 31
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			}
{ !			
(Barent)	COMPANY OF STREET	5 153 200 200 200 300 300 300 300 300 300 30	Corp

MT64-10

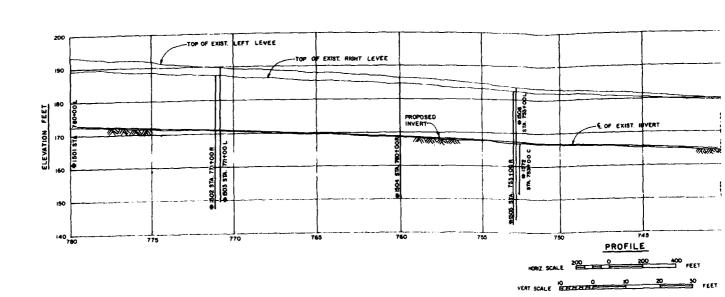
er tractic		Top No	do Elevation Completed - 1-11-1
			library fine to course send wat acre gravel.
			Same at the section tenses of silty sand same page 1.
	-		The control of the co
Or general	Stand Personalian Stant Book	Name of the state	Will in for in benuing the minding and if north entry the nectated benuing the form of the

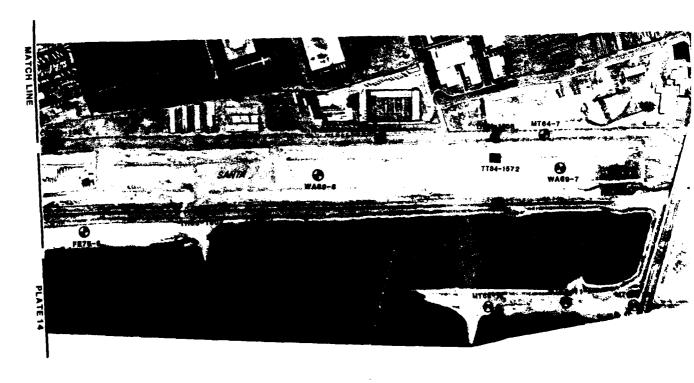
MT64-8

yp•	16" Bucket	Top II	r, 1, 171,4 MORING NO. 8 Ple Elevation (79). Completed -2-10-64
			Brown clean fine to course sand with scattered gravel.
175		1	Drown cleen fine to coarse gravelly sand
120			Rrown clean fine to coarse send with scattered gravel.
		irent scelu-	-rown section some with sitty sand lonses.
Maria (E. Joyattion)			ermin silty medium sand, -rown silty clay, I means of homes silty consum to fine sand entering silty and silty consum to
155		160	Srown stity clay.
150			Boring located wast side better about 50 feet from existing concrete protected for the state of
	Ory demisty (10s ou ft.) Moisture (%) (1%) (2km / beatesten (2km / beatesten	Somple use (orchas) Somple Ne	Parket and

- I. SEE PLATE 14 FOR TEST SITE LOCATIONS.
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SANTE I	REVISIONS								
	1	ALMY ENGINEER DISTRICT LOS ANGELES DRPS OF ENGINEERS							
DESIGNATO ST.	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANOUM								
684 WH 57.	LOGS OF INVESTIGATION								
BY OTHERS									
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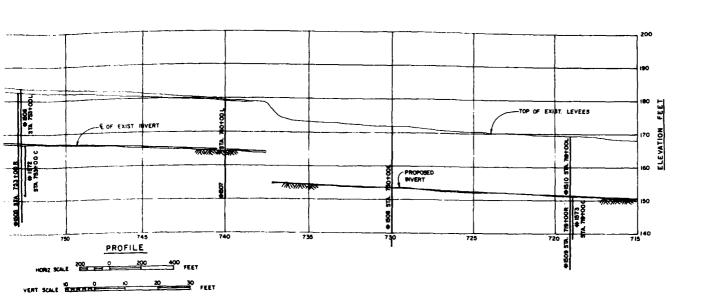


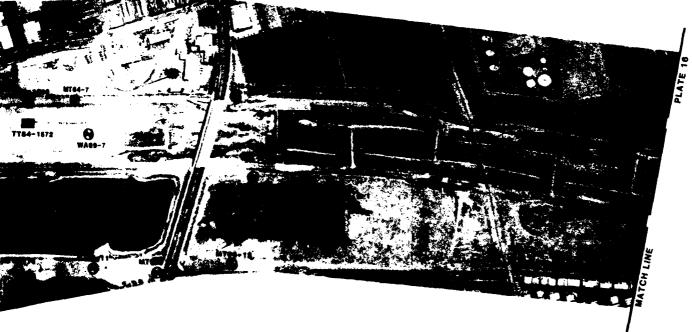




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VALUE ENGINEERING PAYS





- I. SEE PLATE 8 FOR LEGENO AND GENERAL NOTES.
- 2. SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

SYMBOL	THE STATE OF THE S	9478 44790							
	REVISIONS	1 2.00							
	1	MINIT BIGINESS DISTRICT LOS AMORLES DRPS OF ENGINEERS							
SANTA ANA RIVER MARISTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM									
SEAWN SK	PLAN AND PROFILE								
STA.780+00 TO STA.715+0\)									

VALUE ENGINEERING PAT

TH 84-1501

TH 64-1 501		STA 780+00 L						EL- 194#						
DEPTH	L06	HC	u	ρį	-4	-200	*	DESCRIPTION						
	SP/SM			₩P	91	9		SAMO/SILTY SAMO: LIGHT SAMON, MOIST, FIME GRAIMED SAMO, GRAVELS TO 1 INCH-						
3.0					93	3	- 19	SAID: TAM, MOIST, FINE TO MEDIUM GRAINED SAND, SOME GRAVEL TO 3/4 INCHES, ROUNDED, MEDIUM INSHITY, CLEAN-						
					97	3	12							
		4			98	3	ı,	SAME: TAN, MOIST, FINE GRAINED SAME, SOME STREAKS OF BLACK (ORGANIC).						
	ዎ	3		_	88	3	u	SAFE: LIGHT BROWN-MULTICOLORED, COARSE GRAINED SAND-						
		3			77	1	7	GRAVELLY SAND: SAME AS ABOVE, GRAVEL TO 2-1/2 INCHES-						
		3			94	3	16	SAND: TAN, COARSE GRAINED SAND, GRAVEL TO 2-1/2 INCHES-						
					38	4	29	SAME: TAM, MEDIUM DENSITY, FEW GRAVEL-						
·a							30							
0_	3P/SP			*	98	9		SMB/SILTY SMB: MEDIUM BROWN WITH MULTICOLOREN GRAINS, COMES GRAINED SMB. SOME COMESTON.						
.2	Þ				97	4	37	SMID: MEDIUM BROWN WITH MULTICOLORED GRAIMS, COMPSE GRAINED SAND.						
-	39/SP			₽	99,	5	14	SMID/SILTY SMID: LIGHT BROWN, MOIST TO MET, FINE TO COMMISE OR ALMED SMID, SOME GRAVEL.						
5							19							

TH 83-1502

TH84-1502				131 77.	1+00 R			£. 188±				
DEPTH ———	1.06	NC.	u	PI	~4	-200	ĸ	DESCRIPTION				
								SAND/SILTY SAND: PROMIL MOIST, DENSE, I GRAINED SAND, FEW GRAVEL, ASPHALT SURFAL				
		<u>.</u>		HР	98	10		The desired, resident Supply				
		.5_					56					
		<u>.6</u>		NP	97	10	54					
	SW/SM	7										
		_					55					
								SAME. PROMY-GREY, NO PENTROMETER TEST D STEEL FOUND IN HOLE:				
				MP	97	12	R					
4.5		6					37					
								SANT): BROWN, MOIST, MEDIUM GRAINED SAND				
	20	6		MP	98	4	25					
20.0		7						SAME: GREY-BROWN, WET-				
	\$9/\$#	25			93	5	22	SANDY/SJLTY SAND; BROWN, HET, COARSE GR				
5.0							13					
	3#	28		WP	92	23	1,7	SILTY SAND: BROWN, WET, FINE TO COARSE				
7.0							27					
5.5	24.20	24		MP.	100	· ·		SAMP/SILTY SAMP. SAME AS ABOVE.				
		η	46	22	100	7ŋ	23	SAMTIY CLAY: PROMI, NET.				
	ů,	37	49	23	89	73	15	SAFF: REDOLSH-BROWN, MEY SCHE SPANE,				
		27	3 2	12	94	56		GRAVELLY SANDY CLAY: REDDISH-BROWN, WE				
							23	CLAYEY GRAVELLY SAND: REDDISH BROWN -				
		72	17	30	60	18		The second secon				

ALUE ENGINEERING PAYS

TH 83-1502

TH 84 1503

	STA	771+00	٩			<u>F</u> L · 188±	TH84-15	03		S1	A 771+	00 L			EL - 190#
W	u.	P! -	•	- 200	*	PESCRIPTION	DEPTH		**	Li.	PI	-4	-700	4	DESCRIPTION
<u>.</u>		y 4	8	10	56	CAMPUSIUM SAMP. REGION, HOUSE, DENSE, FINE TO MEDIUM GRAINED SAMP. FEW GRAVEL, ASPHALT SURFACE.	3.0				;	100	53		SMMY SILT. LIGHT BROWN, MOIST, FINE GRAINED SAND, FBM GRAVEL, SOME COMESTON.
<u> </u>											MP	97	21)	16	SILTY SAME: LIGHT BROWN, MOIST, FINE GRAINED SAMD, FEW GRAVEL TO 2 INDES IN SIZE-
.š_ ,		¥r ≎	•	•	74									12	SME: BROWN, MOIST FINE GRAINED SAND, CLIMPS OF CONESIVE DAWN BROWN MATERIAL.
					**	CAME REQUARTSREY. NO PENTROPRETER TEST DUE TO DEBRIS AND STEEL FOUND IN HOLE:		S#	•		₩	97	?9	20	
<u>:</u>		ys 9	•	12			<u>12:1</u>							įs	SAN): "ROOM, MOIST, FINE TO COMPSE GRAINED SAMD, SOME GRAME, TO U INCM IN SIZE.
					,-	141 - Senher, Moist, Medical Grained Sand, Fen Gravel			·			96	4	1.7	
		yr ₹	:	•	- 1	124 Techterow xct								. 34	SAME ROOM NOISE, LIDGE, COMPSE SPAINED SAMD, GRAVEL TO CHORES IN SIZE.
25					;	UNTITY ONTO RADIAN, HET COMPRE GRATHED SAND-			**			95	·		SANK MALTICOLORED, MOISY, COUSE, EINE TO COMPSE SRAIMED SANC, SPANEL TO 7 (MORES IN \$125) BESIN ADDING DRILLING MAD TO REDUCE DRIVING
		 ¥ - 3.		٠.	.;	11,71 (AN) POWN, HET, FINE TO COMPSE GRAINED SAND		Ŧ						4,7	Consider Service
24		 •				151 TO SAN THE AT ABOVE							,	:**	THE LIGHT SHOWS, HOLST, RIME GRAINED SAND, STRE GRAVEL TO THE TOWNER IN SIZE, PENEROMETER TEST ENGED WITH THE TOP
r.	45					SYLL (3) Research						 -		21,	
: !!	.,			:		3% Procromanne wet sinkt newel.								٤	
77					,	Pad (* 1887) CAY - Reprise Books, Wet に ERF (ABAY - Y CAM) - Reprise BOOks, Wet に	18.2°,		-			-		. 13	UNDY ILSY TARK BROWN, HOUST TO WEY, STIFF, COMESIVE, ONE SHARE, TO J. THOSE IN SIZE
٠.		٠.			-		10 .2	;				:r:	•4	.,	



- I SEE PLATE 15 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF

STMBCK	procession of the contract of									
37,000		RE	VISIONS							
			U. S. ARMY ENGINE LOS ANGE CORPS OF ENG	LES	ia					
DESCRIP	67.	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN NEMORANDOM LOGS OF INVESTIGATIONS								
SEAWN.	_ _									
CORPS OF ENGINEERS										
ORCHE	**	STA.780+00 TO STA.771+00								

TH84-I504

THEA	1904		STA	760	+00 R			EL. 1871
DEPTH	L06	MC	u.	PI	4	-200	H	DESCRIPTION
							-	SAND/SILTY SAND: BROWN, MOIST, LOOSE, FINE TO MEDIUM BRAINED SAND, FEW GRAVEL TO 3 INCHES!
	SP/SH	3		MP	94	5		
							15	
6.0								
					gi	3	13	SAND: SAME AS ABOVE, LESS FINES, GRAVEL TO 2 INCHES-
								SAME: PROMIN, MOIST, FINE GRAINED SAND, GRAVEL TO 2-1/2".
	99						10	Service of the servic
		4			97		13	SAME: LIGHT BROWN, MOIST, CLEAN, FINE GRAINED SAND, FEN GRAVEL TO 1 INCH-
15.0		•			3/	,	15	GEAVEL TO 1 INCH-
							18	SAND/SILTY SAND: GREY-BROWN, FINE TO COARSE GRAINED SAND, GRAVEL TO 2 INCHES, SOME COMESION-
			•	P	87	12		
	5P/5#						12	
	G 73							
							30R	PENETROPETÉR HIT ROCK -
23.5			-	_	OC	-3 C		SILTY SAME: MEDIUM TO DANK BROWN, MOIST TO HET, LOOSE,
							8	COHESIVE, FINE GRAINED SAND.
	S#			, ;	.00	36		
29-0					99	25	28	
								SAMP/SILTY SAMP. LIGHT BROWN-MULTICOLORED, FINE TO COARSE GRAINED SAMD, SOME SILT.
	50/S#		¥		39	8	23	Services and and area.
33.0								
35.0	20			19	00	3	3 0	SANT: SAME AS ABOVE-
							30	

TT84-1572

	INVE	ERT					I	<u>[84-1572</u>
			2.	14 753	10 0 C			EL- 1572
DEPTH	L76		ů.			-500	*	DESCRIPTION
					¥	ş		SAMD: Malticolomed, Moist, Fine Grained SAMD, 3 INCH LANER OF CLAYEY SILT.
<u>w 35</u>	\$\$				20	1		GRAYELLY SAND: "NULTICOLONED, MOIST, FEW GRAVEL TO } INCH
2.0					96	,		SAMT: PALTICOLORED, MOIST, COMPSE GRAINED SAMD, FEW GRAPEL TO 3 INCH.
0.0	31			¥_	100	29		SILTY SHID: DANK BROWN, PDIST, SOME COMESION.
	SH/SH			•	84	5		FRAVELLY SAMD/SILTY FRANKLLY SAMD: PARTICOLORED, MOIST TO HET, FIRE TO MEDIUM GRAINED SAMD, FEW GRANEL TO 7 INCHES.
<u>ه</u> .ی	·							

TH84-1505

THB4-1	~ 			TA 753	+00 R			Đ.
DEPTH	L06	nc .	Ц	Pį	~4	-200		Desc
		4		10°	96	6		SAND/SILTY SAND: LIGHT I GRAND, TO 3/4 INCHES IN S
							30R	
	SH/SM	,		¥	95	12	30R	SAPE: GREY, MOIST, FINE IN SIZE-
	347 g1						R	PENETROPETER HIT ROOK.
		~		Nb	91	9	30R	
8-0_		,		Ψ	95	9	R	SAME: GREY, MOIST, FINE IN SIZE, CORRLES TO 4 IN LARGE ROOK-
1.0	9P/SH			NP	96	5	30R	SAME: RROWN, MOIST, FIR
5-2	54		?'	:	99	23	15	SILTY SAND: GREY, MOIST COMESIVE.
J.J					96	4	26	SAMD: BROWN, MOEST TO E
				·	26	4	23	SAME: MULTICOLORED-
	à						22	
					98	4	20	
					98	4	20	
٠							34	

FINE

LUE ENGINEERING PAYS

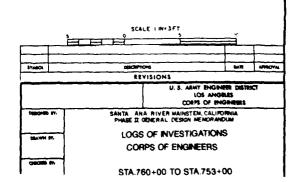
TH84-1505

	STA	7534	00 R			£L. 1832
•	3.	P;	-4	-200	H	DESCRIPTION
Į		¥P	96	4		SAMD/SILTY SAMD: LIGHT BHOWN, MOIST, FINE GRAINED SAMD, GRAVEL TO 5/4 INCHES IN SIZE.
ļ	•				30R	
		¥Ç	ν,	12	3 JR	SAVE: GREY, MOIST, FINE GRAINED SAND, GRAVEL TO $\tilde{5}$ INCHES IN SIZE-
	,				•	PENETROMETER HIT ROCK
ł		NP	91	3	tgg	
		φ	ж,	3	ą	SAME: GREY, MOIST, FINE GRAINED SAMD, GRAVEL TO 3 INCHES. IN SIZE, COMMUS TO 4 INCHES IN SIZE, PENETROMETER MIT LARGE ROOK.
		₩	*	ç	tņe	SAME PROMY, MOIST, FINE GRAINED SAND
		?	-4] F.	SILTY SANO, SHEY, MOIST TO WEY, FIME GRAIMED SAND, COMESIVE-
			*	•	ne.	SAMP GROWN, MOIST TO WET, FINE TO COMPSE GRAINED SAMD.
			ĸ		78	TAME TRATICOLOMED-
					¥ 1	
,			ng.	-	29	

TH84~1506

TH84-1	506		- 2	TA 753	9•00 L			EL. 184±
3:0 6:0 9:0	LOF	HC	u	PI	-4	-200	N	DESCRIPTION
• •	39	1			74	4	36	GRAVELLY SAND: LIGHT BROWN, MOIST, FINE GRAINED SAND, 5 PERCENT CORBLES, GRAVELS SUB-MOULAR TO ANGULAR (1-17, MAX.).
	5P/SM	4		æ	98	5	19	SAID/SILTY SAID: LIGHT BADIN, MOIST, FINE GRAINED SAID FEN GRAVEL.
6.0								CMD. Cara ta man
	29				98	4	18	SAMD: SAME AS ABOVE.
- U-E	SW/SM			ND.	98	8	16	SAND/SILTY SAND: SANE AS ABOVE.
12.0					99		.,	SAMD: SAME AS ABOVE.
		,				,	16	
					97	4	18	SAME: LIGHT BROWN, MOIST, COARSE GRAINED SAND, SUB-ROUNDED GRAVEL TO 1/2 INCHES-
	99							
							16	
2.0						·	16	
29.0_	α.	25	41	16	100	67	16	SAMDY CLAY: DANK BROWN, MOIST TO MET, NO GRAVELS, FINE GRAINED SAMD, STIFF CONSISTENCY.
	SW/SM			WР	100	9	2?	SAND/SILTY SMID: DARK BROWN, MOIST TO NET, FINE GRAINER SAND, MEDIUM DENSITY.
27.6	574	2		NP.	93	?3	22	SILTY SAMD: TAH, MOIST, COARSE GRAINED SAMD, SUB-MIGULE TO SUB-ROUNDED GRAVEL (1/2 INCH MAK-), MEDIUM DENSITY-
0.0								
	90	-			190	4	40	SAM): TAW, MOIST, FINE GRAINED SAMO, 5 PERCENT GRAVEL 1 17: IMCH, DEMSE:
					99	3	37	
6.0								SANDY SILT. PARK BROWN, MOIST TO WET, FINE GRAINED SAND
	٩.	34	43	14	95	18	12	SOME GRAVEL, CONESTVE

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	er.	A 740+	0 0 1			€L. 180*	THB4-15	ine		CT	00.0		១. 16
				-200		DESCRIPTION						-200	N DESCRIF
3		IP.	82	8		GRAVELLY SAND/SILTY GRAVELLY SAND: BROWN, MOIST, FINE TO COLORED GRAVINED SAND, GRAVEL TO 2 INCHES IN SIZE, SOME SILT.		SP/SH				,	SAND/SILTY SAND: LIGHT BROW ROUNDED TO HOUNDED GRAVEL TO
			92		30R	SAND/SILTY SAND: SAME AS ANOVE-	3.0	SW/SH					SMID/SILTY SMID: SAME AS ALL
			_				6:0						SILTY SAMD: SAME AS ABOVE.
					30R					ų.	96	16	3(F1) 24(n): 245 v2 v20cr.
5		MP	95	1				SP1		W	93	n	SAME: GARRY, MOIST, COMESIV
_			87		35 52	SAVE: GRAVEL TO 3 INCHES, SOME COBBLES TO 4-1/2 INCHES-						19	SME: GREY, MOIST, SOME SU
_							18.0			~	,, 		
		₩	97	7	20			3P/SP		ψ	81	5	GRAVELLY SANDASILTY GRAVEL TO I INCH. I
27	33	9	100	74	5	SAMOY SILT: PROMM, MOIST TO WET, COMESIVE, FINE GRAINED SAMO, STIFF.		4.	•	4]]4	96	52	SAMPY STLT: PLANK BROWN, MI
	37	9	100	80	19			ML/N.		χο 7	100	51	SANDY SILT/SANDY CLAY: BRO GRAINED SAND.
18		₩	100	23		SILTY SAIN: BROWN, MOIST TO WET, FINE STAINED SAID, SOME CONESION.		SM		•	96	13	SILTY SAND: LIGHT BROWN.
						_	202	99/38		φ	99	5	SAMP/STLTY SAMD: SAME AS
				I	<u> 184</u>	<u>— 1508</u>	53:0			···			SAND/SILTY SAND: SAME AS
						EL. 172t							
MC 6	LL.	P!	95	-200 -3		DESCRIPTION SAMD: LIGHT BADAH, MOIST, FINE BRAINED SAMD, SOME GRAVEL TO 1/7 INON IN SIZE, SOME SILT.		2ñ\a		ųp	97	6	
					17		40.0	-	-				
						Cambridge Camp							
		Ψ	99	,	16	SHIUTILIT SHU: "MULTICOLORED, MUIST FIRE TO LUMISE GRAINED SHID, GRAME, TO 2 INCHES; SOME SILT-							
		•	98	5	25	SMO/SILTY SMO: Light Brown, MDIST, FINE GRAINED SAND, SONE GRAVEL TO $1\!-\!1/2$ INCN IN SIZE, SONE SILT.			INVE	ERT.		Ī	T 84 - 1573
											19+00	: 	FL-
					19		DEPT	+ L0	. #C		1 -	-200	D N hest
		w	 36	13	17	SILTY SAMO: MULTICOLONED, MOIST, PINE TO COMPSE GRAINED SAMO, GRAME, TO 7 INCHES IN SIZE, SOME SILT-					90) 1	SAMD: MULTICOLONED, RIME L
**					***			4			9	,	SAME: MOIST, COMPSE GRA
													SAME CONTRACTOR OF YOR
			30	4	34	SAMO: SAME AS ABOVE-					9	7	SAME: FEN GRAVEL TO \$ 11
			98	29		STLTY SAND: BROWN, MOIST, COMESIVE, FINE TO COMESE GRAINED SAND, MEDIUM DENSE, GRAVEL TO 3/4 INCHES IN SIZE-		0			3 10	0 6	9 SANTOY CLAY GREYISH BRO
								3			9	5	0 SAND: MULTICOLONED, MOT SAND, FER SEARCE, TO 1 LH
			39	4	3 1	SMMD: Light BROWN, MOIST TO NET, FINE TO COMPSE GRAINED SMMD, GRANEL TO [77 INCH IN SIZE, SOME SILT.							
	5 5 27 18	5 27 33 37 19 S1 MC LL 5	S IP 10 17 18 19 17 18 19 19 19 10 10 10 10 10 10 10	## 92 ## 92 ## 92 ## 95 ## 97 27 33 9 100 57 9 100 19 ## 130 *** 35 ## 99 ## 99 ## 99 ## 99 ## 98	NC LL P -4 -200	MC (L P! -4 200 M 3 NP 82 8 NP 92 8 30R 50R 50R 50R 97 7 50 27 33 9 100 74 5 37 9 100 80 19 19 P 130 23 TH84 S14 730400 L **C LL P! -4 -200 N 5 95 3 8 17 **P 99 7 16 **P 99 7 16 **P 99 7 16 **P 99 7 16 **P 99 7 16 **P 99 7 16 **P 99 7 16 **P 99 7 16 **P 99 7 16	No.		Marrier Marr	No. 11	March 1	March 10 10 10 10 10 10 10 1	March Marc

ALUE ENGINEERING PAYS

1	ļ.				THE	34 - 1509
ł	• •	FA 71	9+00 R			EL · 169±
1	ш	PI	4	-290		DESCRIPTION
		MP	95	,		SAMO/SILTY SAMO: LIGHT BROOM, MOIST, FINE SAMO, SOME SUB- ROLHOED TO ROLHOED GRAPEL TO I INCH.
		*	89	7		SAND/SILTY SMID: SAME AS ABOVE, GRAMEL TO 2 (MOJES, VERY ORIGIN.)
		¥	96	16		SILTY SAMT: SAME AS ABOVE, MOIST-
	;	Ψ.	93	n		DME HERY, MOIST, COMESIVE, SOME ORGANICS, DENSE,
		₩	95	18		SAME RAEY, MOIST, SOME SUBMOUNDED GRAVEL TO E INCH.
		₩	91	5		TRAVELLY SAND/SILTY GRAVELLY SAND: LIGHT BROWN, MOIST, REMOTE GRAVEL TO 1 IN., DENSE, FINE GRAINED SAND.
-	4;	14	95			SAN'Y SILT THAN BROWN, MOIST, COMESIVE, FEW GRAVEL.
	.39	7	100	51		TAMPY TJ.T/SAMINY TLAY: BRITING, MOLST, COMESTVE, FINE SHALMED SAME.
-		•	*	13		COTY SAND LIGHT BROWN, MOIST, LOOSE, FINE GRAINED SAND-
		•	99	;		SAMP/SILTY SAMD - SAME AS ABOVE-
		*	97	1		SMOUSILTY SMOD. SAME AS ABOVE.

TH84 - 1510

TH84-					9+00 L			EL · 1692				
DEPT	L06	MC	u	PI	4	-200	1	DESCRIPTION				
		3			87	?		SAMD: LIGHT BROWN, MOIST, LOOSE, FINE GRAINED SAMD, GRAPPEL TO 1 INCH.				
	_				96	4	30	SAPE: CLUMPS OF DARK BROWN, COMESTVE MATERIAL.				
	39				87	3	48	SAFE: FINE TO COARSE GRAINED SAND, GRAVEL TO 2 INCHE PENETROMETER HIT ROOK.				
							30					
2.0	n			₩	100	n	30	SAMBY SILT: BROWN, MOIST, FIRM, FIME GRAINED SAMB-				
5-0	SM	16	24	3	100	42	5	SILTY SAND: DRK BROWN, MOIST, CONESIVE, FINE GRAINED SAND-				
8-0					97	3		SMO: LIGHT BROWN, MOIST, FIME GRAINED SAND, FEM GRAIN TO 1/2 INCH.				
	æ						26					
					99	,	23	SAPE: Brown-				
7.0				ΙΦ	97	5	13	SAND/SILTY SAND: LIGHT BROWN, HOIST, FINE TO COARSE GRAINED SAND, FEW GRAVEL TO 1/2 INCH.				
	5P/SA						23					
			-	*	97	5	37					
.0	۹.		21	1	99	60	5	SANDY SILT: THARK BROWN-GREY, MOIST, FINE GRAINED SAND CONESIVE, SOFT.				
.0	ď.	17	30	17	99	n	-	SANDY CLAY: "ROWN, MOIST, FINE TO MEDI'M GRAINED SAND				

TT 84 - 1573

VERT

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	۶	TA 713	+90 f		FL: 151±		
•	LL.	Pį	4	-? 3 f	T PESCRIPTION	۹.	
			Ж	:	SAND MALTICOLONED, FINE TO MEDIUM GRAINED.		
			93	;	"APE MOIST, COMPSE GRAINED SAND, FON GRAVEL TO L (EHCH-
			97	:	TATE FEW SPAYEL TO 5 INCH, FBW COMMUES TO 5 INCH-		
	51	25	100	69	SARRY CLAY: AREYISH BROWN, HOLST, COMESTVE-		
			95	1	SAYO: PLATICOLORED, HOIST TO WET, YEAY CHARSE HRAIN SAND, FRISHBARE TO 1 1804		HED

NOTES

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SCALE I IN-3FT

SYMBOL	GENCHIFTIONS	DATE	APPROVA
	REVISIONS		
	1	AY ENGINEER DISTI LOS ANGELES PS OF ENGINEERS	ICT
CERCHED SY.	SANTA ANA RIVER MAINSTE PHASE II GENERAL DESIGN		
District ST.	LOGS OF INVESTIG	BATIONS	
	CORPS OF ENGIN	EERS	
	STA.740+00 TO STA	.719+00	

F E 7-5-1	FE75-4	<u>FE75-</u>
LOG OF TEST HOLE	LOG OF TEST HOLE	LOG OF
THE DO 4 SO DESCRIPTION	TH-4 MC OO 4 200 O ESCRIPTION	71/8 40 00 4 500
SITY SAND- Daterbed, Ness, damp. SILTY SAND- Sand \(\) fine grave! SILTY SAND- Sand \(\) fine grave! Agent 7 102 100 10 Sand \(\) fine nead, bra, damp.	182' SANO - Lease, disturbed 4 100 100 5 SANO - Brown, damp, med dense	O' SANDY SILT B. SANDY Med 1 isolated
5' SILT- Bray-bry, moist to wet, med to soft.	neavy caving	
Ground water at 1½.	7H-4A <u>FE75-4A</u>	SILT. Moist, bin
TH-2	SAND- Brown, demp, loose on Surface, med dense with depth	SAMO- Brown, TROST to MA
5 107 95 15 SAUSS Sits & Small greet layers of some small greet layers, some small preset of some small greet of some small greet layers.	more maisture	
Sees. Clear, more mosture with depth.	TH-S FE75-5 SILTY SAND - Brey-brn, disturbed	77-1 FE75-
SILTY SAID - Met, caving the Sciencely.	7 106 100 5 SAND - Most, some gravel Cross- bedded diluvial	6 100 25 S
	layers, dense	
7W-3 <u>FE75-3</u>	SILTY SAND- Brn, most b	4 100 5
SAND - Brn. damp, med.		5 12 100 35 5
25' Sift at 24' Small layer	SAND- With fine gravel wet, periodic caving	6 100 5
12 Yeary wet sand.		
Gering severely.	Hemy caring.	22 100 55 3
Excepated 2-19-23	Excepted 2-24-75	Excessive 2-24-75
Ground water at 4%.	No ground water	No ground water

WA69-6

alit 2.6 Rotary bash	-C.E	Control	175.9		LECT	: et		o,ç.	7.	_
PONCHATER BEFTH	ecte :	514WF112	6 Inch		2018	0-11	LEB '	6/19	/69	
SOIL DESCO	f*: 60			7			7	100	<u> </u>	7
		T		Ta:	****	-	-	- 4	1	
BESCE-FFI IP WE GENERAL	E94.00	W0 - 57 = 4 F	CD45+54	1191		1	1	لقة		i
Fine to Medium Silty SAMD	Le coy	Noist	Locse	SM				ĺ		
Medium SAND Percolation Test A	Lt Gy	Polet	M Dense	SP	- 5	ĺ	ĺ	I	ı	1
from 5 to 7 feet	1	Ì	ĺ	! {	. 10	1				
Perculation Test B from 10 to 12,5 feet								Ц	ĺ	,
Fine Silty SAND and Sandy SILT	Rd Brn	Motet to Vet	H Dense	SH HL	15			I	ĺ	1
from 15 to 17 feet	ļ	l	1		. 70	1	[]		. (
CLAY	Pd Brn	Vet	liste	·*	. 10			I		,
Sandy GRAVEL with few cobbies	ON BES	Upt	V Dener	СP	75			I	ı	.0
with large cobbles and boulders		-,-			***					
PUTTON OF HULE AT 11 FEET		PIELD	RECOLAT	ON D	7A 1w 35	Γ		7		
1) Caving of boring walls curt with use of extra thick dri mud.	ilere'	3) 39	ened 000 feet 000 feet							
7: Hole not bailed to determin groundwater level. 3) Mole terminated due to seve drilling conditions, causi- elou prograss, Many cobble and some boulders.										
Santa Ana River : SASSIDATES Overce County, Call		T	11/11	1 0 L		•		I	H 0 L	

WA 69-7

MILL BIG ROTATY Wash	MOLE I	11111100	107.9		1	1.50	DCF	_
ROUNGWATER DEPTH		HAPETER	6 Inc				9 6/1	. 5 -
					1.		1177	- 3
ZOIT BEZEI		,		!	.,	:	1.1	
BESCH-PITCH AND ACHINES	CG7 0#	8615.446	C745-57			3		ă Î
Siley SAND	Lt Cy	Dry to	Louise	98			TT	- ;
	1	Hotel	M Dense			i	1 1	į
Percolation Test A	Ì	1	1			1 :	- 1	
(0 to 5')	Matt'es	Vet	H Denre	70	٠,	į I		1
Jenny Gental	Cy Brn	1	1			1		1
Hedium SAND	Lt Cy	Vet	Dense	5P-		: :		i
	1		ļ	1	19	١.	14	
	1	ļ		}		i l	1 1	
	1	1]	į	ļ		j
Percolation Test 8 (10 to 15')	1	1	1		- 15	1	\perp	- 1
	(1	į į		1 -	H	- (
	1	l	!		ŀ	1		1
Percolation Test C	1	i	1	į ,		1:		- 1
(15 to 70')	-	1	1	i i	241	1:	H	ĺ
	j	ļ	}		ŀ	1	\Box	- !
	.L _	1		1 -		1	1 1	í
Siley CLAY	Dk CV	Hotet-	V Stiff	cr	25	1		1
	1	1	1	1	İ	11		- 1
	1	1	1			1		i
	L	l	ļ —	1	112	1		j
Fine Silty SAND and Sandy SILT	Lt Cy	Het	Dense	KH-		1	$+$ \Box	+
	ad arn	We c	v 3011	1	t	1		- 1
Siley CLAT		1	[1	١,	1	. 1 1]
		1	1	1	t"			į
CIAYAY GUAVEL WITE TAW CORRIES	1-		-		-	1.	H	110
CIANGO DECARET ALCE TOA CORDIES		1-2-			ţ	1.	╌┼┸┤	- 10
		1 *	DEATION	74	40	1.		1
BOTTOM OF HOLE AT 33.5 PEET HOTES:	i At	200,000	teet/ye	*	t	1		-
1) Coving of boring walls cur	. 10)	23,000	test/ve	•r	1	1		1
telled with use of extra thick driller's mud.	[6)	7,000	seet/ye	*	ĺ	Í		- 1
7) Hole not balled to determi	~~	1	1	!	[1		- 1
groundwater level.	1	ł	1	1	ł	1	1	- 1
 Hole terminated due to severiffications, causing s 	1der		1	1	t	1		İ
progress. Many robbies and co	or boulde	<u> </u>	1	1000	L	l_	┵┵	بلي
WA WARLER SINES AND RIVER	Leves	L			1 5	4 6	_4	#811
& ASSOCIATES Ovence County, Cal	I/arnio		- 1	- 3/16	789	* ***		•
711 0 1170 - 9107817 91	CR . (84.00	03	A0	~B/18	789		- 1	

CALLE BIG ROTATS
Fine Silty SAND
SAND
with few gravel
Fine Stity SAND
2-inch thick grav Sandy SILT
CLAY
Sendy CIAY
Fine Clavey SANT
WA WARLER SO

- I. SEE PLATE 15
- 2. SEE TABLES 4 FROM WHICH TH AND EXPLANATION
- 3 1068 BY STUE

LUE ENGINEERING PAYS

TH-8 MC [00] 4 [30] DESCRIPTION SANOY SUF. Brown, damp, suff.

0'- E: 1:E	SANDY SILT. Brown, demp, Saft.
	SAND- Med brn, damp. Isolated coving.
4 hin	SILT: Maist, ann, soft.
2	SAND- Brown, fine to coarse, most to wet, caving.

)	6	100	25	SILTY SAND- Brn, Fine to med.
	4	95	5	SAND - Brown, fine to coarse
	4	100	5	Some cering.
5	17	100	35	SILTY SANO- Brn. meist. Fine
	TT			SAND . Brown, fine to course,
	- 6	100	5	demp.
	22	100	55	SANDY SILT - BAN, K WIT, MAN SOFT

WM74-1

		Б	Į		1	-	-	
MP711, FT	BABPLCS	BLOME / POO	SHOUND WATE	DESCRIPTION	UMC COMP. BYREHOTH,	MOISTURE CONTENT, "	DAY DEMBITY pef	07 ME 12 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 1
URFA	CE	ËLE	VATIO					_
-	П			Fill: Loose, dry, brown, fine-to coarse-grained SAMD(SN) some fine- medium FRAVEL				
- -	,	13	S₩	Fill: Medium dense, deme, tan fine-to medium-grained SAMD (SP), micaceous		١,	96 -	SA
+	,		511	Thin leases of dark brown SILTY CLAY (CL)	_],	194	Si
1	١		J.,	Medium dense, damp, gray fine-to medium-grained GRAVEL (GF) Medium dense, damp to moist, tan fine-to medium-grained SAMD (SF)		["		
,			┢	Then lenses of brown-green SILTY CLAY (CL.)				ŀ
	3	١.		Medium stiff, wet, brown CLAT (CL)	4	2,	,,	70
,-		1	-	Loose-medium dense, wet, brown SANDT SILT (NL) to SILTY SAND (SH) GRAVELLY	_			
-	,	,m	₽.	Dense, wet, tam GRAVELLY SAND (SW) to SANDY GRAVEL (GM-GM)				l
								١
1								
_								
1								
	1	l	1		- 1	ŀ		1

WA 69-8

From \$16 Rotary Work	- Post I	ETATION	162,5		10666	0 81	D.C	.r.
Committe State See Motes	HOLE	146.65	6 tn	ch	DATE BRILLED 6/11-17/69			
SØIL BESC	11 P1 + 04				7.	1 3		
chico et da ma almines	C01.00	80 151 WR4	C045157	10 IL	ECPTA	=	5 55	WE BELLE
ine Silty SAND	Crey	Dry	Loose	SM				
	!	:	H Jense					
CYAS	+	ve:	1 1et -r	1	. 5.			
	1	Í		! į			i	i
	1			[10		++1	
			ļ	1				
with few gravel			ļ		15	1	Щ	17
	1]		
	J				20			1 1
Fine Stity SAKD	Grey	Wet	M Dense	SM		1		
Z-inch thick gravet layer Sendy SILT	Rd Prn	ĺ.,	Stiff	la.	. 25	1		
sendy SILI	Ka grn	•••	31,11	["	•	1		1 1
			İ		. 30	1		
CLAY	Rd Bra	Wet	V SELFF	cī	. ,0	1	F	
	İ					}		
	1				. 35	1	4.	"
		}	1			1		
Serie CLAT	Rd Brn	Motet	5-166	ci.	40	ł	1	1 1
			}			1	H-	'
			1		43	1	-	1
tine Clayey SAMP	Rd Brn	Wrt	H Dense	SC		1	I FT	1 10
		<u>l </u>	<u> </u>	17,174	50	ł.	Ш.,	LL
# A MARLES Santo Ala River L & ASSOCIATES Orange County, Cali	****		1111	0 0 1		• •	<u> </u>	HOLE

NOTES:

21 207

. 1451

II.

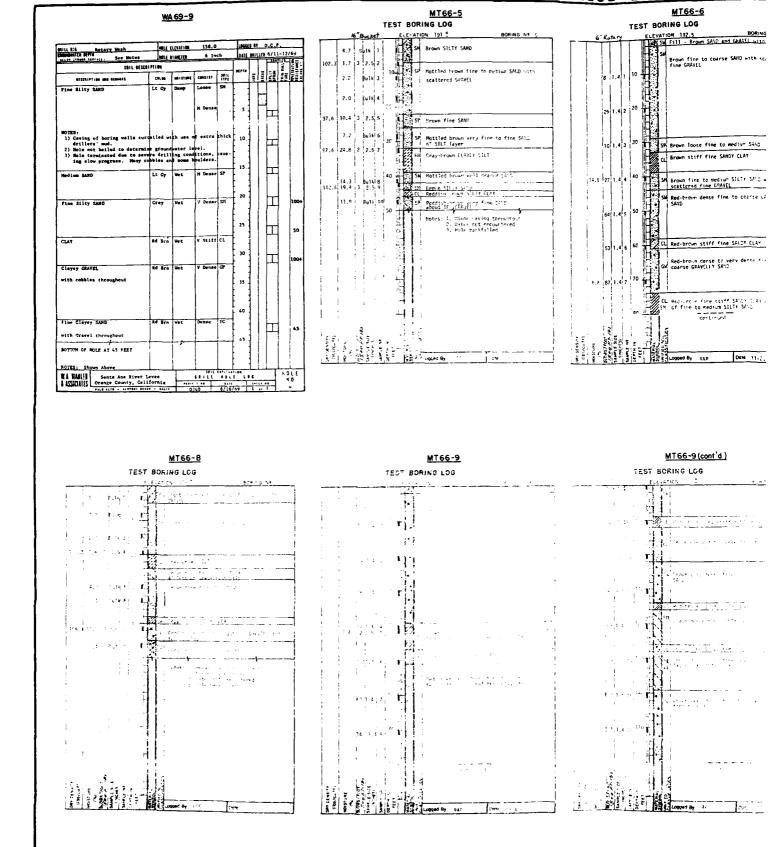
SEE PLATE IS FOR TEST SITE LOCATIONS.

2 SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.

<u>WA69-8</u> (cont'd)

Pitt Ris Rotary Wish Rotanutiff Sprin		HAVETER	6 1	ı,ch	-		0.0 (0.67)	1-1-64
SOIL DESCA	~					Ħ	Ξ.,	
describition was remarke	COLDS MISTERS		COMS 157 1996		06*1*	1	1	
Sendy CLAY	Rd ben	Vet	V Stiff	CL .	55			
BOTTOM OF HOLE AT 59.3 FEE	<u> </u>				60		H	1 22
NOTES: 1) Caving of boring walls curt with use of extre thick dri mud. 2) Hole not balted to determing roundwater level. 3) Hole terminated dur to seve drilling conditions, causing allow progress. Hany cobble and some boulders.	llere'				65			
TO A WANTER Sante And River L B ASSOCIATES Orence County, Col:	ornia	71511	CRILL	<u>- 7</u>	. Le	1-1	<u> </u>	HGLE

SYMBOL	089CHPTICH4		FAD	APPRO
	REVIS	IONS		
		U. S. ARMY ENGINEE LOS ANGEL CORPS OF ENG	ES	T
SLEGPED BY.		RIVER MAINSTEM, CALIFOR ERAL DESIGN MEMORANDI		
DRAWN SY.	LOGS	OF INVESTIGATION		
ORGED IN		BY OTHERS		
	STA.780+	-00 TO STA.715+00	ı	
SUBMITTED BY:	DATE	SPEC. NO. DACWOF-		544



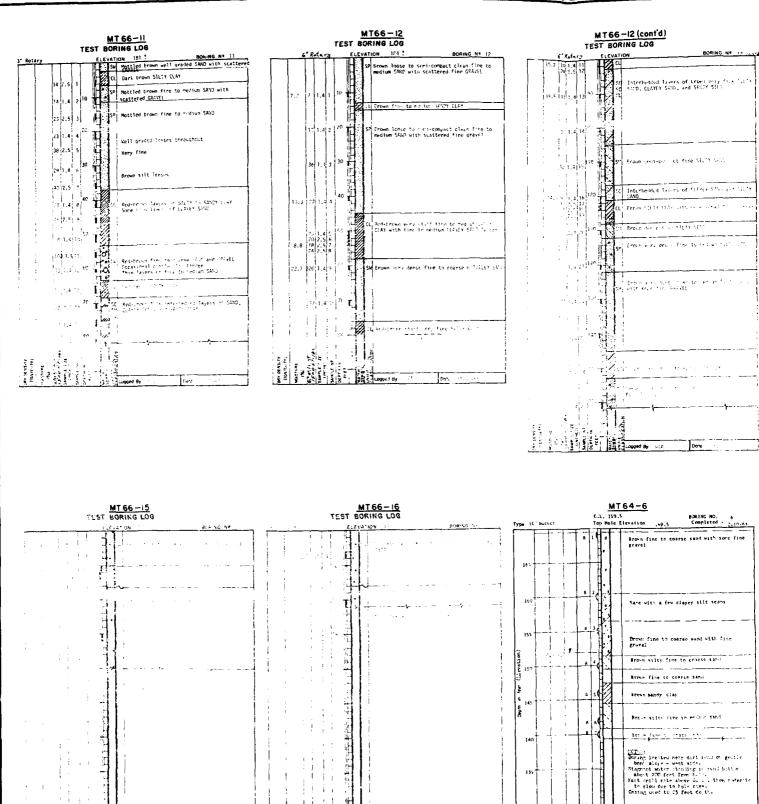
VALUE ENGINEERING PAYS MT66-6 MT66-6 (cont'd.) MT66-7 TEST BORING LOG TEST BORING LOG TEST BORING LOG ELEVATION 192.5 BORING NET

ST. SM Fill - Prom SAND and GRAVEL with plea 192.5 EVATION 190 1 ELEVATION 192.5 Brown fine to coarse SAND with scattered fine GRAVEL 9 7.5 7 10 + Brown very dense fine to coarse GRAVELLY SAMO with some coarse GRAVEL 431 15 1.4 3, 11-1 100 🖺 .] 31 2.5 4 26 17.3 3C SP Brown loose fine to medium SAND CL Grown stiff fine SANDY CLAY su Pottled From 1.11 graded 1865 SC! Red-brown illreit SANO with 102 GAT EL SM Brown dense fine to medium SILTY SAND SM Brown fine to medium SILTY SAND with scattered fine GRAVEL SW Red-brown dense fine to coerse GRAVELLY Brown fine to coarse SARD with fine to SAN Red-brown dense fine to coerse Gf 13 1.d. 13 130 CL Brown stiff SiLTY CLAT with layer; of dense 13 2.3 16 St. 15 From dense fine SILTY SAHO Gray-trown SICT 5710 Fed-timen SILTS (124 Red-broin dense to very dense fine to SII Brown very dense fine to coarse GRAVELLY 70 Tights, meeted troom Story GRAVEL OL Outs on a fine colff SAGE SLAF with tayers of fire to medium SILTY SAGE

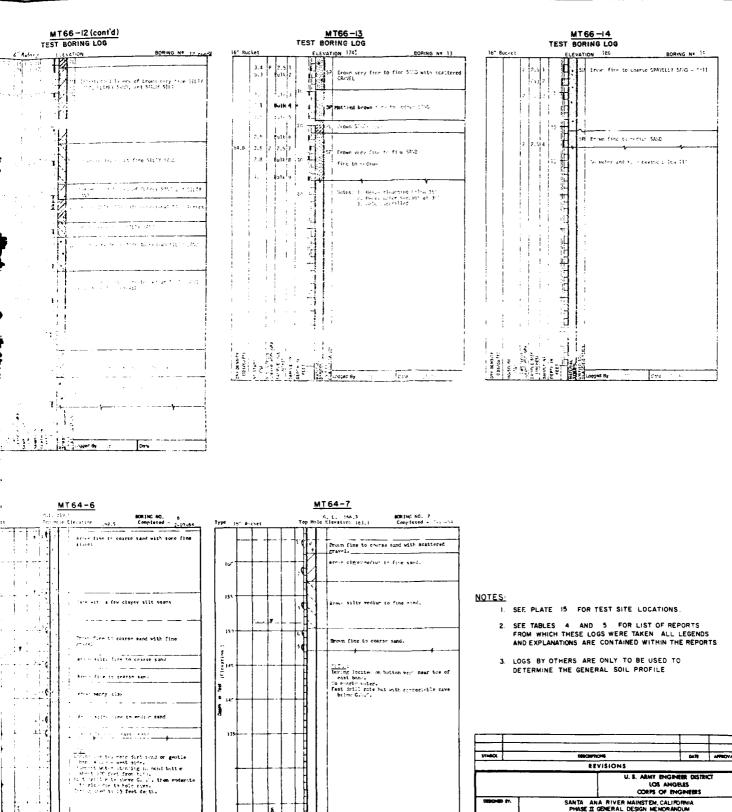
Softimum Tassp Interbedded brown dense SILTY SAND and very dense GRAVELLY SAND Date 11-2.3-65 25 2.5 21 36 2.5 22 60 2.5 23 A Mary Locoped By Date 11-2,3-65 MT66-10 MT66-9 (cont'd) MT66-9 (cont'd.) TEST BORING LOG TEST BORING LOG TEST BORING LOG ELEVATION 183 1 FLEVATION I'M Editor

Francis (1) Strong (1) St - 13 c. 1 c. 1 c. 1 c. 1 Personal Constitution of the Constitution 3.3 Mostfor between the actions to it. 40.00 True growt Miles to THE MICHAEL PRINCIPLE OF THE PROPERTY OF THE P i tymbu, men ii The series was a first of the pro-ference of the first of the pro-Constanting on the form of the series of the series of the pro-More thank series of the pro-REVISIONS U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM NOTES: LOGS OF INVESTIGATION 1. SEE PLATE IS FOR TEST SITE LOCATIONS. BY OTHERS SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS STA.780+00 TO STA.715+00 SPEC. NO. DACWOR-____ B-___

VALUE ENGINEERING PAY



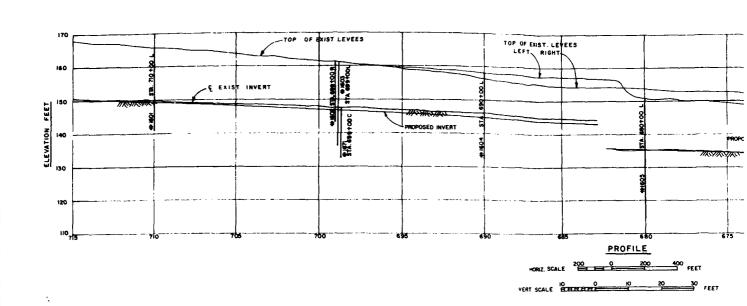
LUE ENGINEERING PAYS

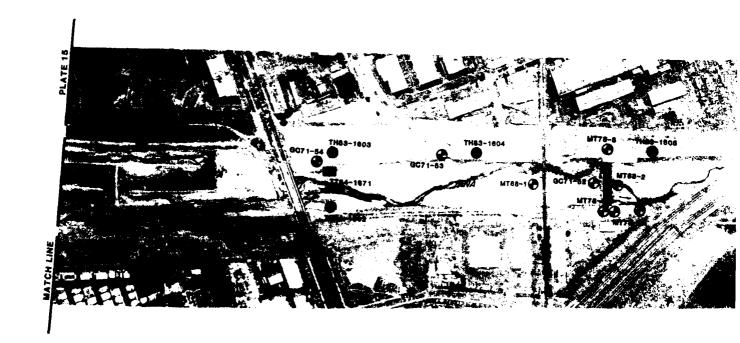


LOGS OF INVESTIGATION
BY OTHERS
STA.715+00 TO STA.650+00

SPEC. NO. DACWOF-____B-___

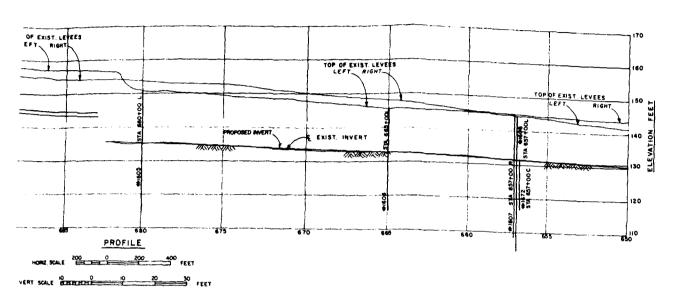
VALUE ENGINEERING PAY

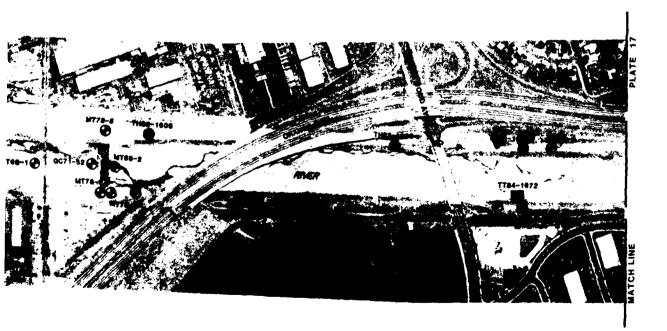






ALUE ENGINEERING PAYS







- I. SEE PLATE 6 FOR LEGEND AND GENERAL NOTES.
- 2. SEE SUBSECUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

	ATUM IS MATIONAL GEODETIC VE	TICAL DATUM OF 1929								
			 							
SYMBOL	SSSC SIETTONS	DATE	APPROVAL							
	REVISION									
		U. S. ARMY ENGINEER DISTRI LOS ANGELES CORPS OF ENGINEERS	c a							
8800-40 P		SANTA ANA RIVER MARSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM								
BRANCH ST.	PLAN AND PR	OFILE								
Crecitie III.	STA.7 15+00 TO ST.	4 .650+00								
SUBMITTED BY	APPROVED SPEC	MQ DACWOR	SHEET							

TH84-1601

TH 84-1	60 <u>n</u>		2	TA 710	90 L			EL - 1662
DEPTH	1.06	MC	ш	P]	4	٠. ٥	N	DESCRIPTION
								SAND: BROWN, MOIST, FINE GRAINED SAND, COMMLES TO 6 INCH. SOME SILT.
	92	5			89	4		
							50	
6.0								
							60	GRAVELLY SAMP/SILTY SRAVELLY SAMD: BROWN, MDIST, FINE TO COARSE GRAINED SAMD, COMMLES TO 7 INCH, SOME SILT-
	SN/SM	5		NP.	82	3		
							60	
12.0								
					94	4	24	SAND: BROWN, MOIST, FINE TO COARSE GRAINED SAND, COMMLES TO 7 INCH, SOME SILT.
	æ	_			92		ıı	
	•	•			74	•		
							25	
21.0								SAND/SILTY SAND: BROWN, MOISY, FINE TO COMPSE GRAINED
22.0	SH/SH			Ψ.	98		21	SAND, COMPLES TO 7 INCH. SOME SILT. SAND: LIGHT BROWN, MOIST, FINE TO COMPSE GRAINED SAND-
	92				99	3		Series Claus mounts (State Claus III Charles Georgian State)
25.1							23	

TT84-167)

INVERT

4-55	τ.		51	A 6994	99.1		EL - 1482					
EPTH	_Y.	*	-t	3 1	-4	-/10	4	DESCRIPTION				
	P				19	:		SAMP: MULTICOLIMED, MEDIUM GRAINED SAND.				
5:2					49	1		FRAFELY SAID. MULTICALORED, MOIST, COMME GRAIMED SAID SPAREL TO 7 INCH.				
	79			Ψ	243)<		SILTY SMID DAM MAYAN, MOIST, SOME CONESION, FINE SHAIMED SAND.				
2.2.												
2:1	æ				39	2		SMID. PLETICOLORED, MOIST, FINE GRAINED.				
	34			*	17	רי		STOTY SMITH - IGHT BROWN, MOIST, CONESIVE, FINE GRAINED SMITH.				
<u></u> .												

TH83-1603

TH#3~1	503		\$	74 69	3+00 L			EL. 161#
DE PTH	F06	MC	l.	P:	4	-200	N	DESCRIPTION
	SH	5		ЖP	96	21		SILTY SAID: BROWN, MOIST, GRAVEL TO 1 INCH.
3-0		10	19	2	99	31	19	SAME: SLIGHTLY COMESIVE, GRAVEL TO 3/4 INC
5.0	SPVSC	14	27	-,	96	50	18	SILTY SAND/CLAYEY SAND: BROWN, MOIST, 9.15- BRAVEL TO 3/4 INCHES-
	sc	12	28	12	99	18		CLAYEY SAND: BROWN-RED. HOIST-
7.0 9.0	529	•	16	,	98	18	28	SILTY SAID: PROME, MOIST, MEDIUM TO COMPSE GRAVEL TO 1-1/2 INCH-
	SAVSC	12	25	÷	94	35	20	SILTY SAND/QLAYEY SAND: BROWN, HOIST, © 154 GRAMEL TO 3/8 INCH-
12-0	54	5		Ψ.	95	13	18	SILTY SAND: LIGHT BROWN TO GREY, MOIST, SRA
15-0	SP/SM	4		 ye	97		8	SAND/SILTY SAND: LIGHT BRN. GREY, MOIST. SE
18-0	ф	3			95	4	8	SAND: LIGHT GREY, FEW GRAVE, TO 1-172 INCH.
21 <u>.0</u> 22.0	SHASH	17		-w-	- 94-			SMO/SILTY SMIT: 1.1SHT GREY, SATURATED, SEW 1-1/2 INDES-
	SM		21	·	99	39		SILTY SMID: LIGHT SROWN, SATURATED FINE GR
24.0	4	21	25		100	60	31	SANDY SILT: LIGHT BROWN, SATURATED, FINE GRO

TH83-1604

* 48 3-1	504		\$ 14 590	+90 t			Ft. 159±
DEPTH	FUe		 	-4	-270	N	in a subject to the s
1-0_	25	_2_	 	94	4		SAND: GREY, MEDIUM GRAINED SAND, FEN GRAVE
3.0	SH/SM	4	 Ab.	37	8	50	SAND/SILTY SAND: GREY-LIGHT MICH. WITT - SAND: GRAVEL TO 3/4 INCH.
	3 5	4		97	4	40	SANT: GREYTLIGHT BROWN, MOIST, MEDIUM GRAIN GRAVEL TO 3/4 IMCHES
. 5 .:C	20 /SH		 %.	96	4	13	SAND/SILTY SAND: SREY-LIGHT BROWN, MOIST HI GRAIMED SAND, GRAVEL TO 5/9 IMDRES:
1.3		5		95	4	Į4	SAMD: GREY-LIGHT BROWN, "DIK", "EDIHM TO DIS SAMD, GRAVEL TO 3/4 INCHES.
						23	
	ф				3		
		٠. د	 		<u>.</u>	74	
18.0		13	 	-36	1_		SAFE - SATIRATED
		2*		à	3	32	Just Authority
1.0							
	\$P/\$P	•	*	97	5	22	SAND/SILTY SAND GRAY, SATURATED, MEDIUM TO GRAINED SAND, GRAVEL TO T/A INCHES.
4.0	æ	19	 	39			SMID: GREY, SATURATED, "EDILIN TO COARSE GRE
6.0							BRAFEL TO 3/4 INCHES.

VALUE ENGINEERING PAYS

TH83-1603

	\$	FA 699	-0 0 L			EL · 161±						
MC	ш	Pl	-4	-230	N	DESCRIPTION						
5		MP.	96	21		SILTY SAND: BROWN, MOIST, GRAVEL TO 1 INCH-						
13	19	2	79	31	19	SAME: SLIGHTLY COMESTVE, GRAVEL TO 3/4 INCHES-						
[4	27	, ^	*		18	SILTY SAND/FLAYEY SAND: BROWN, MOIST, SLIGHT CONESIVE GRAVEL TO $3/4$ INCHES						
12	.75	13	×	:-		CLAYEY SANT ROOM-RED, MOIST-						
	16	1	*	1.5	÷	SE TY SANTE ROOM, MOIST, MEDIUM TO COARSE GRAINED SAND. SRAFE, TO 1-1/2 INCH.						
12	25	6	1 <u>u</u>	:.		SHOWN, MINIST, SLIGHTLY CONESTVE, SHAWEL TO \$79 INCH-						
,		19 0	 34	:	13	COTY SANC LIGHT BROWN TO GREY, MOIST, GRAVEL TO 3/9".						
4		Mb.	·		,	SMN/SILTY SMN- LIGHT BRN. GREY, MOIST, GRAVEL TO 3/8".						
						Takin Tohr shev, FRH dirams, to 1-172 thich-						
;		W	- T			THE STATE THEY SATURATED, SEN GRAVEL TO						
	11		33	73		TO CAN'T (134" SROWN) SATURATED, FINE GRAINED SAND						
	Zt.	2	,ı		r.	IANDY SIL"						

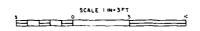
TH83-1604

\$74.590+00; _	Fil. 159±
er pr	2 JEWINITH
2 2 2	REY TEDI M GRAINED SAND, FEW GRAVEL TO 72
. ΨP .* .	THE THE TAMES GREYTLISHE RACHEL MOIST MEDITAL GRAINED AND JOANEL TO THE LINES.
. "	AT THE PULLSHIE BROWN, MITST, MEDIUM GRAIMED SAND, HAVE, PUTTA INQUES.
. V S ,	AN' (1. "r SAN') - SPEYFLESHT BROWN, MOIST, MEDIUM TO
. •	THAT HE THAT TO \$74 INCHES
з и	SMC GREY-13HT BROWN, MOIST METH M TO CHARSE GRAINED MC CHARSE TO \$10 (MCHES)
	:
• • • • • • • • • • • • • • • • • • •	
A	
<u>.</u>	AF CERTS.
2 4 	HAY THE FY FAME GRAM SATURATED, METHUR TO COMPSE PAINED SAND GRAMEL TO 374 EMONES.
13 19 1	TAYO THEFY, SATURATED MEDIUM TO GOARSE GRAINED SAND. GRANE TO THE INCHES.

TH83-1602

TH83~11	502		S	TA 6994	100 K		£L. 161‡						
DEPTH	L06	MC	_ u	PĮ	-4	-200	н	DESCRIPTION					
								CLAYEY GRAVELLY SAND: DARK BROWN-RED, MOIST, CORBLES TO 12 INCHES.					
							50						
	sc												
							37						
								SAME: SPANEL TO 2-INCH, SLIGHTLY CONESIVE-					
9.0							18						
								SMDY CLAY: DARK BROWN-RED, MDIST, COHESIVE, SOME GRAVE TO 3-INCH, CAVING AT 14 FEET.					
	α						9						
5-0	50						9	A NOW FIRM					
6.0)ı.							CLAYEY SAME IS ABOVE.					
	50/54							SANT: GREY, MOIST, GRAMEL TO 1-INCH-					
8.0							8						

- 1 SEE PLATE 16 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVER". IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.



SYMBOL	DESCRIPTIONS	DATE	APPROVA
	REVISIONS		
	l u	Y ENGINEER DISTR OS ANGELES S OF ENGINEERS	icī
DESIGNED BY:	SANTA ANA RIVER MAINSTEI PHASE II GENERAL DESIGN M		
DEAWN SY.	LOGS OF INVESTIG	ATIONS	
- (CORPS OF ENGIN	EERS	
Officials In			
İ	STA.710+00 TO STA	690+00	

TH83-1605

TH 83-1	605		\$	TA 680	+00 L			EL- 151#
DEPTH	L06	MC	u	PI	-4	-200	N	DESCRIPTION
1-0	sc		29	10	93	Ð	50	CLAYEY SAND: BROWN, HOIST, GRAVEL TO 3", CORRLES TO 5".
2.5	SIVSC	4	26	6	99	15	•••	SILTY SAMD/QLAYEY SAMD: GREY, MOIST, GRAVEL TO 1 INCH-
	sc	7	29	10	99	27	43	CLAYEY SAND: BRN, HOIST, SLIGHTLY CONESIVE FINE GRAINED
4.0	SP/SH	3	=	-	*			SAND/SILTY SAND: BROWN, MOIST, MEDIUM GRAINED SAND GRAVELS TO 1/2 INCH-
6-0							41	
		1			97_			SATE: MEDIUM TO COARSE GRAINED GRAVELS UP TO 3/4 INCHES FOR FIRES.
		2			97	3		
	92	2		_	97		8	
		_					21	
		5			100	4		SAME: LIGHT BROWN, MOIST, FINE TO MEDIUM GRAINED-
14.5		3		_	99		11	SME: BROWN, MEDIUM TO COMPSE GRAINED-
	sc	8	27	8	100	22	-	OLAYEY SAND: BRN, FINE TO HEDILM GRAINED, MOIST SLIGHTLY
6.5								
	a.	18	26	8	100	52	22	SMIDY CLAY: BROWN, COMESTVE, MOIST-
19-0	SP/SH	4		NP	100	6		SAND/SILTY SAND: CLEAN, MOIST-
21-0							24	
	sc	16	37	v	77	47		CLAYEY SAND: BROWN, MOIST, PLASTIC GRAVELS TO 3 INCHES, CORBULES TO 5 INCHES.
24.0							12	
	60	12	v	9	50	26		CLAYEY SANDY GRAVEL: SAME AS ABOME-
26.5							46	
	6W/GM	,	23	6	48	10		SILTY SANDY GRAVEL: BRN, MOIST, MEDIUM TO COARSE GRAINES BRAVELS TO 3 IMCHES, COBBLES TO 5 INCHES
	OH / GE	•		ū		10		
30.0								CLAVEY CHAPM COLUCT BROWN AND CO. MITTIGHT TO COMPANY
	GM/GC	6	27	10	35	6		CLAYEY SANDY GRAVEL. BROWN, MOIST, MEDIUM TO COARSE GRAINED, COBBLES TO 7 INCHES.
33.0								
	6P/6C	5	24	8	49	9		SAME.
56 -0								
N.17								BOULDER AT BOTTON (36 FEET)

TH84-1672

DEPTH LOS	*	U,	PI	-4		
₩ 10 %				-4	-230	DESCRIPTION
,				120	2	SMIT: LIGHT BAN-MULTICOLORED, MOIST TO MET, FINE GRAINED
3 0						
			Ψ	15	5	SAND/SILTY SAND: MULTICOLORED, WET, COARSE GRAINED, FEM GRAVEL TO I INCH-
3P/S#						
			#	31	5	SAME: FEW GRAVEL TO 2 THON-
10-1						
						SAMP. MULTICOLORED, WET, COARSE GRAINED, FOR COMPLES TO 9 INCH.
30				49	5	
15-0						

TH83-1606

THB3-1606			S	TA 665	+00 L			EL 145±
DEPTH	L06	MC	ш	P1	-4	-200	ĸ	DESCRIPTION
2.0	sc	4	30	18 12	86 90		29	CLAYEY SAID: BRM, MOIST, NO COMES- SAME: MEDIUM DENSITY GRAVEL TO 1
		3		NP	97	5	48	SMID/SILTY SMID: COARSE GRAINED, I LIGHT GREY-BROWN, GRAVEL TO I (NOW
		2		МЪ	95	5	15	
	SP/SM	3		*	96	8		
0.0		3		Nº	96	5	10	
0.5 1.0 2.0	25-24	27 52	30 30	1	100	- 73	16	SARTY SILT: BOOM, HOLST, SLIGHTLY SARTY SILTY SART: BOOM, HOLST, NO SARTY SILT: BROWN, HOLST, CONESTVE
L 14.0	SP	7			99	4		SMID: BROWN, MOIST, HEDIUM TO COM
6-0		14			99	4		SAFE: LIGHT BROWN, WET, NO CONESIO
	SP/SR	23		ИP	99	9	5	SMB/SILTY SMB: LIGHT BROWN, SATU MEDIUM TO COMPSE-GRAINED
0.0		21		*	98	7	•	
	591	29_	. 24	3	100	. 50	7	SILTY SANT: DARK GREY BROWN, SATUR
4.0	•	23	24	3	100	47	5	
26-0	4.	34	31	7	99	80	,	SANDY STET. PROME, SATURATED, COME
w.w	α.	31	37	15	94	80		SAMOY CLAY: BROWN, SATURATED, COM
	u	25	31	11	98	54		
30.0								

TH83-1608

THB3-15	i08	_	\$1	A 557	•00 L			EL: 1451
DEPTH	L06	MC.	LL	٥Į	-4	-200	4	DESCRIPTION
1:0	SIVSI 12	-}-	30	10 10	83 97		50	SMD/SLT SMD: SRN. MOIST, COARSE SI CLAYEY SAND: BROWN, MOIST, MEDIJA
		3		¥	98	6	39	SILTY SAND: RROWN, MOIST, MEDIUM
	Sb\ZM	-		.	99			SAME: SPANEL TO 1/2".
6.0							17	
2.0	29				37	2		SAND: LIGHT BROWN, MOIST, LOAPSE
		19	37	11	100	55		SMITY DAY, BROWN "SREVISH , MOT
	0.	16	29	1,	100	50	A	
		16	32	74	99	59		SAME: REDDISH BACHN, SLIGHT CON€
14-0	3P/SC	12	74	, ,	100	45	13	STLTY/SAND/CLAYEY SAND REDRISH CONESTVE
		17		#F	100	45		STUTY SAME - GREYTSH BROWN, MOTST GRAINED SAME IN 17.
	54	,		W.	199	13	20	SME: No conjection, printe to hebbi
		6		₩¢	100	70		
21.0							11	
22.5	n.	27	23	;	100	59 		SAMIY STUT: REDUCTSH BROWN, MITS
	54	18		*	100	29	g	SILTY SAND: REDDISH BROWN, MOIS
25.Q_	n.	24	71	۰ ۰.	100	82		SANDY STLT: REDISH MICHIN, MOTS
27.5					100	•••	7	SANOY CLAY - REDDISH BROWN, MOIS

ALUE ENGINEERING PAYS

TH83-1606

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MELL I

¥ 1...

ESIM. COMETIV

. COF61

r covers

1	ST	A 665	-00 L			£L · 145\$					
	ıı	PI	4	-200	4	DESCRIPTION					
COBBLES	34 30	18	36 90	- 73	29	CLAYEY SAND: BRN, MOIST, NO COMES- GRVL TO 3° , COBBLES 6° . SAPE: REDIUM DENSITY GRAVEL TO 1 INCH-					
, MO15T.		NP	97	5	48	SMAD/SILTY SMAD: COARSE GRAINED, DENSE, CLEAN, MOIST, LIGHT GREY-BROWN, GRAVEL TO 1 INCH-					
Ī		MP	95	5							
ſ		ИP	%	8	15						
Ī			98	 5	10						
\equiv	30 30	**	100 100	7	16	SMOY SILT: BROWN, MOIST, SLIGHTLY CONESIVE- CAMPYSILTY SAMD: BROWN, MOIST, NO CONESION- CAMPY SILT: MROWN, MOIST, CONESIVE-					
			99	4	.0	SMITH BROWN, MOIST, MEDIUM TO COMPSE GRAINED-					
	}		99	4		SAME: LIGHT BROWN, HET, NO COHESTON-					
20-E210N	•	ЖP	99	,	5	SAMP/SILTY SAMD: LIGHT SHOWN, SATURATED, NO CONESION MEDIUM TO COARSE-GRAINED.					
		ΨP	98								
SIVE.	24_		100		,	STUTY SAME: DANK GREY BROWN, SATURATED, COHESIVE-					
ı Į	24	3	100	4*	Ę						
ver to :	3:	,	99	33		SANDY ST. ? - PROMY, SATURATER, COMESTIVE, GRAVE, TO 1/2 *-					
VFL TO	17	15	94	80		SMITH TAY, BROWN, SATURATED, COMESTIVE, GRAVEL TO 1/2"-					
1	31	11	98	64							

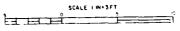
TH83- 608

51	4 657	90			EL: 1451
١.	ΡĮ		-200	4	DESCRIPTION
31	10	39-	<u>.</u>	5-	ACTS TONG Sen. MOIST COMPSE SHO, GRY TO 3" CON. TO 5".
	₩	39	5	1 0	TILTY CAND AROMY, MOTOT, MEDIUM GRAINED, GRAVEL TO ET
	Ψ	30			TATE TO BUT TO LIDE.
)?		17	
					THE LOCAL PROPERTY COAPSE GRADUED GRADUES TO 1/2"
ŧ2	11	100	45	4	SMEN TAY ROWN (SMENTSH , MOTST)
,4	10	1.00	۲.	•	
5		39	59	17	TAME PEDDICH BADAN, SLIGHT CONESIVE.
)q	4	139	45	•	ALTY TIAND TLAYER SAME REDDISH BAN, MOIST, SLIGHTLY DESIRE
	Ψ	100	45		TS OF DAME. SHEATCH BROWN, MOIST, SLIGHTLY CONESTVE, FINE TRANSCORD ON ST
	阜	170	13	×	MY . N. THEOLIN CONE TO MEDIUM GRAINED-
	*	100	*		
21	5	100	59		AND " REDDISH BROWN, HOLST, SOME CONESION-
	φ	190	29	•	TO SMITH. REDDISH BROWN, MOIST, SLIGHTY COMESTVE
7 1	Ą	100	12	,	FROM SP.T. PEOPLISH RATION, MOIST, 92.18HTLY CONESIVE
w)	10	100	94	,	SARDY CLAY REDUISH BROWN, MOIST, SCIENTLY CONESIVE-

TH84 - 1607

TX84-16	07		SI	A 6574	00 R			EL- 1452				
DEPTH	L06	MC	u	PI	-4	-200	N	DESCRIPTION				
		4			93	4		SAND: BROWN, MOIST, LOOSE, FINE GRAINED SAND, FEW COMMLETO 5 INCH.				
	39				99	3	13					
							12					
9.0	SM	31	29	€	100	36	7	SILTY SAMD: LIGHT BROWN, MOIST TO MET, LOOSE, FINE TO COURSE GRAINED SAMD, SOME SILT-				
							19					
15.0	a		34	15	100	71	₹	SAMDY (LAY: BROWN, MOIST, STIFF, CONESIVE, SOME FINE GRAINED SAND AND SILT.				
18-0			30	2	100	52		SAMDY SILT, PROMY, MOIST, STIFF, CONESIVE, SOME FINE GRAINED SAND AND SILT.				
							11					
	٩		29	6	100	65	11	SAME: DANK BROWN, SOME COMESTON-				
		_	34	19	100	74	9					
33 -0												
	¥	9			94	ı	13	GRAVEULY SAND: DARK BROWN, MOIST, FINE GRAINED SAND-				

- I SEE PLATE 16 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL ANE "EXISTING GROUND" ON BACK SIDE OF LEVEE.



			DATE					
SYMPCE	BEVIS	IONS		MASOAN				
		U. S. ARMY ENGINE LOS ANGE CORPS OF ENC	LES	CT .				
OESIGNAD EV.	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM							
DEAWN ST.	LOGS OF INVESTIGATIONS							
	CORP	S OF ENGINEERS						
Geldies IIV	STA.680+00 TO STA.657+00							
BUBINITIED BY:	DATE	SPEC. NO. DACW 09	. F	SHEET				

MT78-8

MOORE & TABER CONSULTING ENGINEERS AND SECUCIONST

TYPE	_	16" 1	ui ke	Α.,	Ret	_			LEV	RING LOG ATION INU.S GORING 8
П	Ī		Γ	Τ	Ra.	R	Ī	Н	3	Brown fine to medium SILTY SAND with GRAVEL & COBBLES - Fill
		111	٠.	1	ļ	,				Sitt modules decreased GRAVEL & COBBLES increased SBLT
51 S.	•	10 8 127	15. 10.	2	ļ.,	,	, 10		1	decreased StLF
	ļ	112	5.	٠,	ļ		15	H	ď	Increased GRAVEL and COBBLES
ļ							20			
	-	ı						H	sr	lan fine to medium SAMD
1		ns	5.	, •	2.5	,	25	Ħ].,	travebroom fine SILTY SAND changing to light brown color, loss Sity then layer fine to medium SAND
-tnv-r	4.	Flev	tion 1.	Ļ	ļ 1	۱ ۲	ľ		Ļ	-tray-brown CIAYED SILT
!	1				***	-	6	Н	Œ	Reddish-brown SILTY SAND with CLAY & GRAVIE
1	1							H.		Red-brown SMSSEE's SARD with meastered CORALES
	ĺ						Ì		<u> </u>	Sorts
	ŀ			1		į		Н	١.	t Societing. No at moderates encomplered.
	i			ļ				H	П	Planted Sty
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:	1	1		1		i		H	П	
,	i	i		ļ			 	H	П	
		Car Bana		100.70	17 ap		:	7.1	7	THIS BORING LOG SUMMARY APPLIES ONLY AT THE TI AND LOCATION INDICATED SUSSIMPACE CONSTITUTES MAT DIFFER AT OTHER LOCATIONS AND TIMES
	H	5 /	ġʻ	li i	11 .	11.	<u> [</u>	12.	134	LOGGED BY THE DATE SEA TH

MT78-9

MOORE & TABER CONSULTING ENGINEERS AND DECUCOST

	MC	ORI	E &	TA	BER	•	0N\$	ULTING ENGINEERS AND GEO. OOIS'S
TYPE	16"	San ket	· · · · ·		TES	T	BQ	RING LOG
								Recent Come to the SLOP SELV CAND WITH SRALL AND CORRES - FEEL
		MSR	6	1.5	10			- Mercinal prapris
						Ħ.		No. 17
					1 1	H	•	1 × 174.1%
						H		To be have a second
0.0 COmpac' Con	Constitution)	100	Sec. 10	1		1,480	101	THIS BORING LOG SUMMARY APPLIES ONLY AT THE TIME AND LOCATION INDICATED SUBSURFACE COMDITIONS MAY DIFFER AT OTHER LOCATIONS AND TIMES
	2 -	ــــــــــــــــــــــــــــــــــــــ	3 \$ 3	- 1 1	1	1.7	3	LOGGED BY :- DATE

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	77	Ť.	6" Bu	ket .
			99	6 ,
			14.5	,
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				MSK
		ш	ingerform	**,
	0.6	10	4	1

GC 71-51

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,	0-							-	-,	0	107.1	7.0	 ;
		Sylvania (: 1	eterte	dang			- M.	3	0	10".:		
- 7		Tertifi Projet		way ro	4. + 61	waner.	-	- SP	ļ.,	0	106.5		
	:	:· •/=						-		0			
					demons		,,,,,	-					

GC 71-52

BOPING No		WE 22-le DRILL CATE 1 12
SURFACE ELEVAT	ION _15'	0°(6 WEIGHT 10 N 10 18 st
WATER ODEPTH FEET CHAPTHE STRISOL	Pack to The Property of the Pr	TEST FEET OF THE CONTRIBUTION C
	In the state of th	
	Tamedisan to a jison yansi b	0, 24 5, 5
-10-		
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	Manager of the state of the Manager of the Manager of the state of the	(1)
-20	Sit Warsh of Province of a derive	- 1 G .26.0 2.0 6.
	TWILE STAND SOM	
-30	SATE OF THE CONTRACT OF THE CO	

ALUE ENGINEERING PAYS

WO THE DR. CATE

C

GC 71-50

	44.1 00						
BORING No	STATION 414 + 60	W.O.,	22-16	4 DF	BLL D	ATE 3/	10/71
CCCVAII	UN	DRIV	NG W	FIGHT	1.1500	15	18 to
[[] [] []	hurter tuger: 16 inch Staneter						
WATER ODEFTH FEET GRAPHIC SYMECL	DESCRIPTION	SCS.	E. RES		CRY CENSITY per	STURE	RELATIVE
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	medium derag] F _{S4}	Ī		İ	 -	1
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5 -	Sir. Sr. White to pray coarse storm to hop, median dense.	SP			_		H
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[25]	The second of th			-		- -	
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GC71-53

воныз ма — (1). Зиягась пирам		WO 27 (C4 DESCE DATE
WATER TOBETH FIET TRAFHIC STRINGL	DESCRIPTION	ORIVING WEIGHT 1/2 1/2
	A second district of the second district of t	[M]
	19 ONTO S. Co. I write to you come of the description of the contract of	SF
-10-111	dze	
	225. Double to project provide Project of the damage of some least i	O
	den in the broken to be a recorded	SM O NO
	Service on the present many	31 (3)
-36-	dena.	

- I SEE PLATE 16 FOR TEST SITE LOCATIONS.
- 2 SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

\$7MBOL	DESCRIPTIONS	DATE	APPROX					
	REVISIONS							
		NY ENGINEER DISTI LOS ANGELES PS OF ENGINEERS	ici					
DEMONS BY:	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM							
DEAWN BY.	LOGS OF INVESTIGATION							
	BY OTHERS	i						
CHECKED BY,	STA.715+00 TO ST	A.650+00						
(ANATTED BY,	DATE	A.650+00	_					

GC 71-54

STATION 453 * 76 W.O. 22-164 OPELL ORDE 1/9/1/1

OPENNEW WEIGHT 1500 16 . 18 in

BORING No	STATION 433 TO	W.O			1500	कर गुर	186
SURFACE ELEV	ATION					10.,	
WATER ODEPTH FEET GRAPHIC	Bucket Auger: 16 inch diameter.	GROUP SYMBOL U.S.C.S.	PENE. RESST. BLOWS/FOOT	CORE	DRY DENSITY oct	MOSTURE CONTENT %	RELATIVE COMPACTION
	Fill: GAYEY SAND: SC: brown, moist, medium dense; some gravel.	- sc					-
1011	NATURAL CRONNO: SAND: SP; white to gray, sedies grained, moist, down.	SP	2	0	05.4	3.6	91
	SANDY SI'T: M. SILTY CLAY, CL., intercolded, moist, firm.	ML CL	1	3	107.5	4.8	93_
13 41	SAVD, SP, white to gray, medium grained, moist, medium derre.	SP	2		104.0		e9 -
20			3	0	101.8	4.5	95
25			10		100.		-
	<u> </u>	<u> </u>	10*	(0)	pt .5	3.4	ób

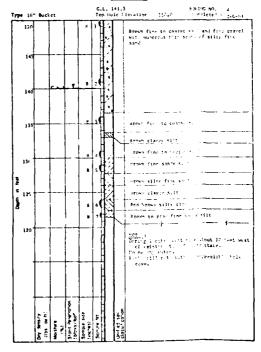
WA 69-10

ATTLERIG COLORY Wish		HOUS.	151.4				5.0.7.	_
ners offer t deat, See Notes		iteittä		r	1:00	<u></u>	.t. 5/11/6	-
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DESCRIPTION AND BEMARES	Carde	-	CCMS151	11/1		=		
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with few Gravel	D'k Gy	-		1	-	1		i
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Sundy CLAY	, Ad 2to	W. C	51	,		1		
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NOTES:	1	1	1	1	-	1	1	
 Caving to be one walls on drillers' and. 	ration w	an week	1 34.	: 1400		1		
2) Hole not berind to deter-	ani areas	<u>.</u>				1		
ing slot pre-term. Many	vete drill	in see.	Tion.		-	ī		
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2.25501415 Lee - Co ev.				7.1	:	۲:	-	3

MT64-3

уp		16	, su e L e	ı		G.L Top	. I	SE. 4 1c. 13	BORING NO. 3 devation 105.0 Completed - 2-6-61
	135				*	1	7		brown first to coarse sund and fine grave! Brown clayey silt
	130				_3_	.0	75.23 N		drown fine sandy sitt
	125				8			!	drow- splity fine sand with a few thin slit
	120					1	11	,	brown convey stit drown fire sandy silt with silty sand search
į	115		_	-			10/1/		Fel-Aroum stity clay
Client o	110			-	8	Ç		-	ICT E. For no located east side bottom about
	tos '	-		-	<u> </u> 				60 feet from bont. He nearly exter in river, Fifth fiet drift rate with no approximate name.
		-	-		-				
		-	-	ş					
		Ory density (13s out!)	1. (Jr.)	Stand Synetherical Control	Sumple 5'26	, A . K		00.00, 00.00	

MT64-4



105____

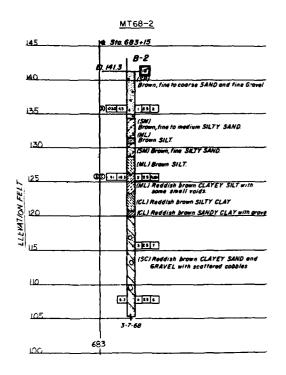
100___

145____

150 (control 1) | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 |

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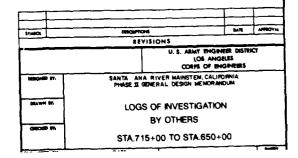
		MT68-I
145	♦ Ste.	686+00
140	El 141.6	B-I SP Brown line to sparse SAND with scattered
<u> 135</u>	⊕ =3••	fine grove! (SP) Brown, fine to medium SAND [18]
I 3 O	(B) (B) (B)	X MALI Brown GLAYEY SILT (CLI Brown SANDY CLAY. 1 1
125	®[F7]ss	(ML) Brown, fine SANDY SILT 2 12100 2 / INL Brown CLAYEY SILT
ELEVATION FEET	<u> </u>	ICL) Reddish brown SILTY CLAY
ELEWI	3 -2-4-44	ICL-MLI Reddish brown SILTY CLAY with thin
ШО	③	· fize I
105	③ •02 • 2	(ML) Reddish brown CLAYEY SILT with occasional
100	® 6. 4⁵	[SM] Reddish brown fine SILTY SANO
	66	17 SW) Reddish brown SAND, GRAVEL and COBBLES

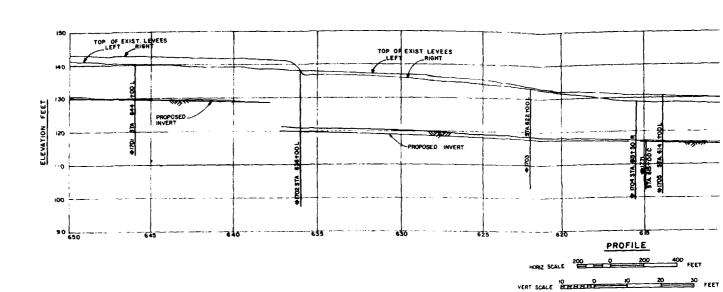


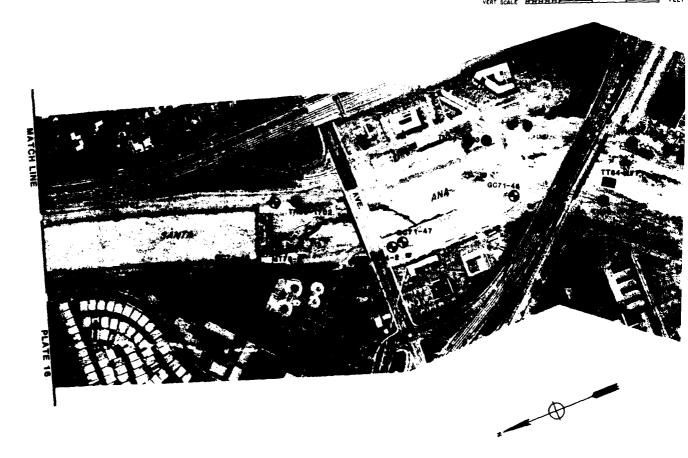
Type 16" nuclet Top Hole Lievation 150.1 Seminated - 5 2-7-64 Top Hole Lievation 150.1 Seminated - 7 2-7-64 Seminated - 7 2-7-6

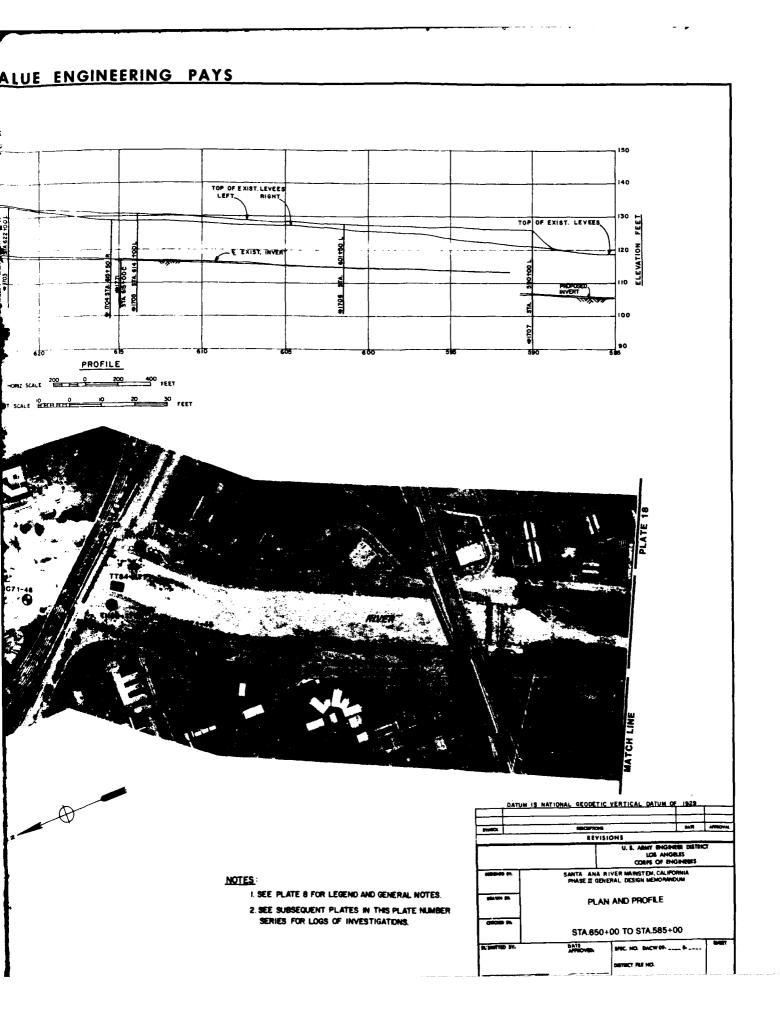
NOTES

- I. SEE PLATE IS FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS
 FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS
 AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE









TH83-1701

1183-1	701		S	TA 644	₩00 L			EL- 140±
DEPTH	L06	MC	u	Pţ	-4	-200	*	DESCRIPTION
1.5	SIVSC.	_5	29		97			SILTY SANS/CLAYEY SAND: BROWN, MET, MEDIUM TO COARSE GRAINED, GRANEL 1-3 INCHES, COMM.ES TO 4 INCHES.
	sc	5	26	8	93	19		QLAYEY SMID: BROWN, MET MEDIUM TO COARSE GRAIMED SMID, GRAVEL TO 1-3 INCHES. COMMLES 4 INCHES.
5.0	59/59	5		WP.	94	5		SAND/SILTY SAND: TROOM, MOIST, COMISE GRAIMED, GRAVELS TO 2 INCHES
	.	6	_	NP	90	6		
9-0							15	
0.5		23	- 58 	28	100	 		SMIDY SILT: GREYISH BROWN, MOIST, CONESTVE-
2.0	39/SM	6		WP.	99	7	13	SAND/SILTY SAND: LIGHT BIN COARSE GRAINED, GRAVELS TO 1"
	SP	8			90	4		SAND: LIGHT BROWN, COARSE GRAINED, GRAVEL TO 1 INCH-
	y	5			100	3	24	
5.0	SP/SM	4		NP.	99	5		SAND/STLTY SAND: BRN, MOIST, COARSE GRAINED, GRYL TO 1".
0.0	9	4			99	4	15	SAMD: 980HH, HOIST, COARSE GRAINED GRAND, TO I INCH-
1.5	sc	11	40	21	34	22	6	SRAYFULY CLAYFY SAND: BRM, MOIST, MED TO COARSE GRAINED- SRAYFL TO 1/2 INCH. COBBLES TO 3 INCHES.
4-0	α	23	31	12	98	52	,	SAMBY CLAY: BROWN, MOIST, MED- GRAINED- GRAVEL TO 1".
5.5	٩.	39	43	15	100	99	,	CLAYEY SILT: REDDISH BROWN, MOIST, CONESIVE-
	CH	32	58	31	100	98	8	CLAY: REXIDESH BROWN, MOEST, CONESTVE-
8.0	1	23	34	13	100	74		SANDY CLAY: REDDISH BACKN, HOIST, COMESTIVE-

TH83-1704

THB3-1/	704		\$	TA 615	5+50 4			EL - 129±
DEPTH	L96	MC	t.t.	Pį	4	-200	N	PESCRIPTION
2.0		11	29	19	*	- 3		LATEY SAME: BROWN, MOIST, MELL GRADED FROM FINE "COMPSE GRAVEL TO 3 INCHES- SAME: MEDIUM GRAINED BRAVEL TO 7 INCHES-
		٩		₩	97	10	26	SAND/SILTY SAND- PRN. MOIST, MED. TO COARSE GRAINED SAND NO CONESION.
<i>1.</i> 0	SP/SM	3		Ψ	98	5	25	SME: LIGHT BROWN, NO CONESTON, CLEAN GRAVEL TO $1/2^{\circ}$
<i></i>	9	2		¥	99	6	24	SAND: LIGHT BROWN, MOIST, CLEAN, MED. TO COARSE GRAINED, NO COMESION, GRAVEL TO 1/2 INCHES.
9-8		2		180	100	2		
1.0		1		7	10	- 25		SILTY SAID: SECON, HOLST, FIRE, NO CONESION-
	SP/SM	4		φ	79	5		SAMP/SILTY SAMD: MOIST, LIGHT BROWN, MED. TO COARSE GRAINED, NO CO-ESION.
5-0		4		₩	99	5	14	
	_	21	32	13	92	S6		SANDY CLAY: BROWN, HOIST, MEDIUM TO COARSE GRAINED SAND
8.0	2	33	47	20	99	92	5	SME: SOME CONESTON-
n.u	Ü#	34	51	25	100	98	,	CLAY: MOON, MOIST.
2.5	4	50	23	5	100	n	10	SAMBY SILT. GREY, MOIST, FINE GRAINED. SOME CONESION, STEE PLASTICTY.
		26	35	14	100	90	10	CLAY: DARY GREY, BROWN, MOIST, CO-ESIVE-
	J	27	93	17	100	78	6	SAMOY CLAY: SAME AS ABOVE.
29 S		27	41	19	100	77	10	

TH83-1702

£1. 130			100 L	A 636	21		702	
DESCRIP	N	-200	4	ρĮ	LL	#C	L06	ЭЕРТН
CRAVELLY CLAYEY SAID: BROWN, COMBLES TO 4 INCHES. CLAYEY SAND: GREYISH BROWN,	50	29 14	85 93	1	30	¥	SC	2.0
SMD/SILTY SMD: GREY, MOIST GRAVEL TO 1/2 INCHES-	26	5	99	IP.		2	SP/9H	
SAPE: MEDIUM TO COMPSE GRALI	10	5	98	WP.		2	SW/SM	6.5
		4	99	WP		3		
		5	98	ЖP		2	SP/SM	
	13	6	99	₩P		3		
	13	5	99	4		3		9-0
SAND: RREY, MOIST, MED- TO C 1/4 INCH-		4	99			3	26	
SAMDY SILT: BROWN, HET, SOME	16	90	99	5	31	27	٦	6-0
CLAY: BROWN, MET, COHESIVE-		94	100	28	54	37	CH	8.Q 9.Q
SILTY CLAY: PROMY, MET. COM		96	100	19	44	?]	¢.	210
SANDY SILT: BROWN, WET, SOME		70	100	2	27	Z ^Q	۹.	3.0
SILTY SANT: BROWN, HET, SOME		5)	100	1	24	29	S#	
		66	100	2	24	Ţη	•	6.5
CLAYEY SAND: BROWN, MET, SO		81	100	10	34	35	<u>'</u> ;	8.5
SANDY FLAY- BROWN, WET, SOME		78	98	12	35	35		
		69	90	14	35	25	ì	
		72	100	10	52	·1		
SAMMY SILT: MROWN, WE'T, 50M		77	106	9	33	31	4	5. <u>2</u>
SILTY SAMB/CLAYEY SAND FRE		28	99	5	23	71	3#75;	8.0

I VERT		TT84-1771
1184-177	STA 615+00 C	

				00 C	A 6154	ŝĪ			1184-17
∂ε		*	-200	-4	PI	IJ.	*	h	DEPTH
D: MULTICOLORED, MITS VEC TO 1 INCM.	SANO: GRAVEL		ŋ	93					
ARK BROWN, "9"	di.								13
			14	190	13	45		٦	
DV 5161- Jame beddy y	SANDY		69	100	9	45	_		
			51	99	1	24	_		15-0

TH83-1702

z		5	TA 630	5+00 L			EL. 1381
L 06	MC	LL	οį	-4	-200	N	DESCRIPTION
sc	+	3 0	11	85 93	29 14	50	GRAFELLY CLAYEY SAID: BROWN, MOIST GRAFEL TO 3 INCH. COMMES TO 4 INCHES- CLAYEY SAID: GREYISH BROWN, MOIST, GRAFEL TO 1 INCH-
29/S#	2		₩	99	5	26	SAMD/SILTY SAMD: GREY, MOIST, MED. TO FINE GRAIMED- GRAPE, TO 1/2 INCHES
SW/SP4	2		*	26	5	10	SAFE: MEDIUM TO COARSE GRAINED.
	3		HP	99	4		
P/SM	2		₩.	98	5	13	
2	3		•	99	6	15	
? 	3		*	19	5-	13	
39	3			9 9	u		SAND: GREY, MOIST, MED. TO COARSED GRAINED. SRAVEL TO 174 INCH.
٦.	27	Ę	ş	349	90	16	SANDY STLT: BROWN, MET, SOME CONESTON-
CH	57	54	28	(30	94		CLAY: BROWN, HET, COMESIVE-
2	15	44	13	;00	96		SILTY CLAY: ROOM, HEY, COMESTVE-
٩	74	27	:	1.9	77		SAMPY SILT: BROWN, MET, SOME COMESSION-
SM	29	24	:	:200	51		STLTY SANT: SHOWN, WE'T, SOME COMESTON-
	30	24	:	:x:	66		
sc	35	34	1.7	; 10	81		CLAYEY SAND: BROWN, MET. SOME COMESSION-
	35	ŧi,		»;	*3		SANDY (LAY: BROWN, ≪ET, SOME COHES!ON-
1	25	*)r	69		
	51	;;	:	:y	7		
۹	31	11	1	100	,,		SAMPY STUT: PROMIN, WEY, SOME CONESTON-
	29	`1	-:-	*?	28		SILTY SMID/CLAYEY SAND. BROWN, SATURATED, NO-CONESION, HEDIUM TO COMESE GRAFINED SAND.

TT84-1771

						EL. 1175
<u>'</u>	3		٠.	-236	٧	DESCRIPTION
÷			e.			SAMD: MULTICOLORED, MOIST, MEDIUM GRAINED SAND, FEN GRAVE, TO I FROM:
				· ~ -~		Tam become, MOIST.
٦		.,	. •	••		
		•	; •	54		SAMOY SELT: DARK BROWN TO GREY, MOLET TO HET, COMESIVE-
			n	51		

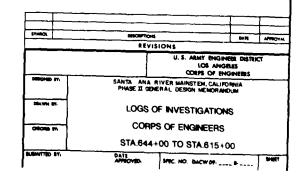
TH83-1703

THB3-1	/03			TA 62	2+00 L			EL- 132±				
DEPTH	L06	MC	LL	PI	4	-200	*	DESCRIPTION				
1-0	SM/SC	4	26		98	_19_		SILTY SAID/CLAYEY SAID: BROWN, MOIST, FINE TO MEDIUM GRAINED SAID, GRAFEL 2 INCHES.				
	sc	4	25	8	99	20		CLAYEY SAND: BROWN, MOIST, FINE TO MEDIUM SAND, GRAV				
	~	9	27	8	99	27		TO 3 INCHES-				
4.0		3			99	3	18					
					100			SAND: GREY, MEDIUM GRAINED SAND, GRAVEL TO 3/4"-				
		•			100	,						
	SP	3			- 99		11	SME: COARSE GRAINED-				
		3			99	2		ore, correct districts				
		_					14					
		3			99	7	17					
2-0												
4.8	Œ.	35 35	42	18	100	- 88 -		SAMIY CLAY: BROWN, MOIST, FINE GRAINED- CLAY: BROWN, MOIST-				
5.0	SH	23		NP.	100	50		SILTY SAND: BROWN, MOIST, FINE GRAINED.				
								SANDY CLAYEY SILT: BROWN, MOIST-				
	M	22	58	27	100	90						
							13					
8.0 7 19 0 0.0	PL.	36	47	71	100	92		CLAYEY STLT: BROWN, MOIST.				
1-3	SC	33	25	10	100	45		CLAYEY SAND: SAME AS ABOVE				
		34	34	12	100	79		SILTY CLAY: YELLOWISH BROWN, WET-				
	CL	36	34	12	100	74		The state of the s				
3.5 3.5	32	71	23	5	99	.25	19	LAYEY SAND: DARK BROWN, MET, MEDIUM TO FINE GRAINED.				
	SP/SM	23		ИP	100	12		SAND/SILTY SAND: SAME AS ABOVE-				
3-0							40					
	α.	27	37	18	100	64	70	SAMDY CLAY: DARK BROWN, NET-				
1·5 1·0	sc		28	9	81	 36		GRAVELLY CLAYEY SAND: BROWN, NET, GRAVEL TO 1 (MCH-				

NOTES

- I SEE PLATE 17 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3. SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT ISED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE





TH83-1705

NB3-17	05		ST	A 614	00 L			EL - 1312
XEPTH .	L06	MC	u	Pį	-4	-200	N	DESCRIPTION
		8.0	32	13	96	99		CLAYEY SAND: DARK BROWN, MOIST, FINE TO MEDIUM SAND, FEW SRAMEL TO 2 INCHES:
	SC	90	31	12	94	45		SME: GRAVEL TO 1 INCH, COMESTVE-
3-0	CL.	11	32	11	39	52	15	SANDY CLAY: DARK BROWN, MOIST, COMESTVE, GRAVEL TO 1° .
4.0	SW/SH	3		180	99	10	20	SAND/SILTY SAND: GREY, MOIST, MEDIUM TO COARSE GRAIN-
5.0	α	19	37	12	99	56		SANDY/SILTY CLAY: DARK BROWN, MOIST, COMESTVE, FINE GRAIMED SAND-
7.0	SW/SM	3		φ	39	12	14	SAMD/SILTY SAMD: BROWN, MOIST, MEDIUM TO COMPSE GRAINER
9.0		17	37	11	100	A 13	12	SMOY (LAY: 1.16HT BROWN, MOIST, COMESTVE, FINE GRAINED-
		18	36	16	100	74	11	
		28	32	. 10	100	76_	12	SAME: "LIGHT YELLOW BROWN.
		20	30	ģ	190	71		
	C.	31	51	15	190	91	5	CAY: LIGHT BROWN, MOIST-
		32	36	14	100	94	15	
		23	32	11	:00	.79		
		_					9	
		23	13	11	100	n		
29 <u>. </u>		10			130			SILTY SAID: DARK BROWN, MOIST, FINE TO MEDIUM SAND

TH83-1706

TH83-17	706		ŞT	A 601+	50 L			£L. 127±
DEPTH	L0G	MC	ŁŁ.	PI	-4	-200	N	DESCRIPTION
	sc.	5	28	10	94	35		GRAVELLY CLAYEY SAND: BRH, MOIST, SOME (
3-0	•	8	30	11	71	32	21	CLAYEY SAND: BROWN, MOIST, GRAVEL TO 3
5.0_	SEVSM	3	-	40	96	6	22	SAMELYSILTY SAME: GREY, MOIST, MEDI-M GR
	GW/GM		25	1	54	11		SAMPY GRAVEL/SILTY SAMPY GRAVEL: BLACY-
7.5 8.6	Ş₩.	~	23	2	79	13	11	STETY SRAVELL SAND: BLACK-DARK BROWN, S
		3		MP.	99	11		SAND/SILTY SAND: DANK GREY, MOIST, MEDI
	50/S#			¥	95	6	22	SAME: GREY, COARSE GRAINED, MAXIMUM 1/?
14.5		•	ĽS	,	97	11	6	SAME: GREY, MOIST, COARSE GRAINED
A1:42			34	15_	-99	- 51		SANDY CLAY: BROWN, FINE SRAINED, 9.1547
	C.	79	74 165	14 14	\$ \$	- 13		D.AY: BROWN, FINE GRAINED, COMESTVE- SAME: LIGHT BROWN, MOIST-
18-0								
10 f	٦	ş.,	₹¢	12	190	96		CLAYEY SILT: LIGHT BROWN, MOIST, COMEST
29.5	1	5.	÷.	9	100	69	3	SANTY CLAY: LIGHT YELLOW-BROWN, 4ET. CO
₩ 24	0	۲,	;·	13	100	73	,	
<u>26.5</u>								

NOTES

3

4

TH83-1706

14 501·	SU L			EL - 1271
25		-240	4	DESCRIPTION
	14	75		GRAVELLY CLAYEY SAND: BRN, MOIST, SOME GRAVEL TO 2".
11	1	ξ'n	21	CLAYEY SAMD: BROWN, MOIST, GRAVEL TO 3 INCHES
чр	¥	-	٠.	SANTYSTELTY SANTY: GREY, MOIST, MEDITAL GRAINED.
	÷+	:		CAMPY GRAVEL/SILTY SAMPY GRAVEL: BLACK-DARK BROWN, COBBLES TO 5", ORGANIC SMELL-
	7	. ir	::	STITY FRANKLL SAND: BLACK-DARK BROWN, SOME ORGANICS, CORRLES TO 5 INCHES.
ų¢.	n	-:		SAND/STUTY SAND- BAPK GREY, MOIST, MEDIUM GRAIN.
·*·	45			SAFE SREY, COARGE GRAINED, MAXIMUM $1/2$ INCHES-
	<u>.</u> .		•	CAME AREY, MOIST, COARSE GRAIMED.
1	75	<u> </u>		CANTY "LA" BROWN, FINE SRAINED, SUIGHT CONESION-
Ħ.	ř	Ţ		CAY: PROM. FIME GRAIMED, COMESIVE. CARE: 134T BROWN, MOIST.
12] Y			TAYER STORY LIGHT BROWN, MOTEST, CONESTVE.
:	. 1			MULA L'EN TENT AETTON-BECHNY MET COMEZINE
	.,	**		

TH83-1707

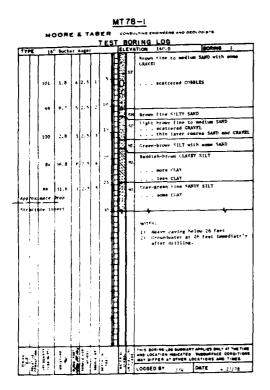
TH83-17	707			TA 591	0+00 L			FL - 1252
DEPTH	L06	MC	ĮĮ.	PI	-4	-200	4	THESCRIPTION
1.5	SH	1		НP	95	16		SILTY SAMD: GREY, DRY, COARSE GRAINED SAND, MON-COHESTY SOME GRAVEL AND ORGANIC MATERIAL.
		18	33	14	99	75	14	SANDY CLAY: BROWN-GREY, MOIST, MEDIUM GRAINED SAND, SLIGHTLY COMESIVE.
		13	26	8	100	55		
	a.	26	45	20	96	98	9	CLAY: BROWN, MOIST, COMESIVE-
		24	30	10	100	67	7	SAMBY CLAY: BROWN-GREY, MOIST, COMESIVE-
12-0 3-0	SA	76		- Ip	100	73		STILTY SAMPL. BROWN, WET, NON-CONESTIVE.
	α	35	42	17	100	90	5	CLAY: GRAY, WET, COMESIVE-
4.5 5.5	54	24		P	100	33		SILTY SANT: RRW, NON-COMESIVE, FINE TO MED. GRAINED SAND
	α	16	25 26	- 8	199	- <u>51</u>	7]	SANTY CLAY: BROWN-GREY, HET, FINE TO MEDIUM GRAINED SAME
7. <u>5</u> 9.5	SP/SM			ΙP	100	12		SANT/SILTY SANT): AREY, NET, NON-CONESIVE
	SPI			₩.	100	19	17	STLTY SAMP GREY, NET, COMPSE GRAINED SAMD.
2.J 4.D	٩.		15	4	120	96	۶	SILT. PREV. HET. SCHOPTLY PLASTIC.
			35	15	130	34	Q	SANTY TAY. ARONN, SCIENTLY CONESIVE.
			Th,	15	190	95	ų	TAY, REY, COMESIVE,
	1		55	12	100	97	13	
2			33	-13	त्ता	- 79		SAMPY CAY SEEV, MOIST, SLIGHTLY CONESIVE.
	SH/SC		28	,	100	l6		STUTY SAMB/CLAYEY SAMD: GREY, MOIST, COMESTVE
.0.	<u> </u>				100	 64		SANDY SILT, GREY, POIST, FIRE TO PESTUP GRAINED SAND

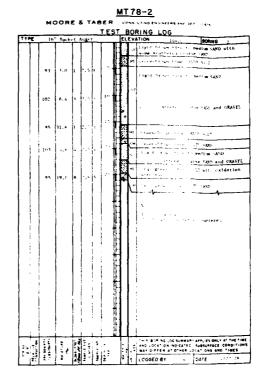
SCALE IN-3FT

NOTES

- SEE PLATE 17 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLIO OR EXCAVATED AND TYPE OF EQUIPMENT USED
- ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE

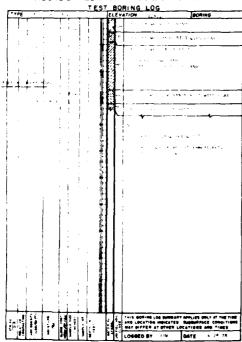
EYMBOL	DESCRIPTIONS	DATE	APPRO						
	REVISIONS								
		ARMY ENGINEER DISTR LOS ANGELES ORPS OF ENGINEERS	ICT						
DESIGNED SY.		ANA RIVER MAINSTEM, CALIFORNIA E II GENERAL DESIGN MEMORANDUM							
CEAWN ST.	LOGS OF INVES	TIGATIONS							
O8030 In.	CORPS OF ENGINEERS								
ì	STA.614+00 TO STA.590+00								







MT 78-7									
MOORE & TABER I CINS THIS END STEEDS AND GET	0 ***								
TEST BORING LOG									
EL EVATION .	Tenera								



GC 71-43

BORN No	STITION II.	W ORICL DATE 1 TOOM
SURFICE CLUVAS	908 H	t - Jewist 1 1 March 18 th
WATER GLEPTH - FEET GHASHIC S1**GGL	BECCRETION	COPE OF EACH O
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BC+	or No. 1971 Services	
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BORNES Ford an NAV

DATE

MT78-3

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MOORE &	TABER	40.00	THO THOMETERS AND GEO. AND STO

TYPE	15."	Mary & C	t Augst		E	EVA	TION	LOG	BORING)
					A CO A CO		1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	time to make the control of the cont	edium CTETY SAND with CONNLES - FIII f modules Targe boulder -
	1	7	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	:	1.	T,		CATION INDICA	WARTAPPLIES ONLT AT THE T TED SUBSURFACE CONDITI TE COCATIONS AND TIMES

1			-	ger				ELE	VA	TION 125.0 BORING 3A
	120	12.5	~	7.5		3	THEFT	0.0.0	,	Rrown SILTS SAXP WITH CLAY and some GRAVEC - FELL
	u,	13.1	,	ļ., '	2	100	1		,,	Front fine to medium SAND = Fill SAND intermixed with grew SANDI:
}	129	25.0	F	5	ļ,	15		11/1	F.	remongrations CANDY SILT
1	٥,	77.9	r	1.5	-			///////		, , s attered - emented modules
c.	-	nvert			ţ-	_ 25	F			Teen intown time STITY SAND
						The state of the s				Model 1 Dickloreducing Dickloreducing Dickloreducing at 30 feet (5) 1 bour after rel310(g)

GC 71-44

6.	STATE STATE	wo protest that the second
		1,200
-		
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NOTES

- I SEE PLATE IT FOR TEST SITE LOCATIONS
- 2 SEE TABLES 4 AND 5 FOR LIST OF REPORTS
 FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS
 AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOL PROFILE

SYMBOL	DESCRIPTIONS		DATE	APPROVA				
	REVISION	\$						
		U. S. ARMY ENGINE LOS ANGE CORPS OF EN	RES	.ct				
DESIGNED BY.	SANTA ANA RIVE	R MAINSTEM CALIFO DESIGN MEMORAN	PNIA DUM					
DRAWN ST	LOGS OF INVESTIGATION							
	BY OTHERS							
OWCORD PT-	STA 650+00 T	O STA.585+00						
SUBMITTED BY.	DATE SE	EC NO DACW 09.	₽	SHOPET				

GC71-45

anain	ıi No	45	STATION 365 + 49	W.D. 27-164 DRILL DATE 3/10,71
SURF	CE C	LEVAT	ION	DRIVING WEIGHT 1500 15 18 1-
WATER	ODEPTH FEET	GRAFHIC SYMBOL	Pocket Juget. To such disserter. DESCRIPTION	U.S.C.S. U.S.C.S. U.S.C.S. PELE, RESS.C. BLOWS/FOOT CORE D DISTY pet HOSSI USE COLTENT % FILLATIVE FILLATIVE FILLATIVE FILLATIVE
	- 0 -		FILL: STITE SAME SM. brown, moist. models.	581
			<u>SARIO SP.</u> brown, coarse guained, moist, medium dense.	SH
	- 5 -		STEP SAID SV: been, moter, middles	SM 3
	-10-		8-1000: 13 .0 5/80: 5157- 8 brown,	
			SILIA 1986 o. brown, toust, or dawn	ML : O LVI. 9 25 0 6.
	-15 -		dipor.	<u> </u>
-				- SK
-	-20-		Solid Server, Moret, Error	ML 7 (3) 46.125.3 E.
			of the second se	SM
F.=	-2-			
-	- : 0-			

GC 71-46

URF	ACE D	LEVAT	ton 177			64 GP WEIGHT			
WATER	ОЕРТН РЕЕТ	GP.4PHIC SYMBOL	Bucket Auger: 16 inch diameter. DESCRIPTION	3000 3 mb	125 HESST 311	CC - CO - CO - CO - CO - CO - CO - CO -	C'ASITY pet	CONTENT %	PELATIVE
	0		FILL SILTY CARD: St. brown, merry, medium deurce.		: ! !				
	- 5 -	1#	SALMY SILE. BL. Br. w., relat., f	E	-				
	-10-		Sith Sim Manager to the dense.			0	115.		1
_	-15 -		MARKET CLOSE WAY SAIT IN CO. Oct. farm.	 -		1		- 	Ī
	-29-		SHTV-000-101, bower, room, first the section deposits		:	[0]	58		1
	-21		<u>1870-1970</u> - 1870 - 18		· !				-
_	-32					1			=1

GC 71-49

BORIN: 100	STATION 1 1	WID 22-161 DRULL DATE 112 1
SURFACE E CANDION	11	DRIVING WEIGHT THE THE LET
WATER GROWN FEE. GROWNEL GROWNEL GROWNEL	DESCRIPTION	ONCE STATES USES FREE PROPERTY OF A COLOR OF COL
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	e general de la companya de la companya de la companya de la companya de la companya de la companya de la comp La companya de la companya de	.,,
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-15	Talon Programma and Albania	
-20 1007	The first with a state of the community	m 0
- 10	Service of the servic	

MT 64-1

Type 14	Jacobi	G. L. Top Ite	113.5 BERTON 1. 1 PROCEEDINGS 1. 1 PROCE
110.			APPENDING TO THE TAX TO THE APPENDING PERM
furth			7 1 1 1 1 1 1 1 1 1
Depth of field (i lawythmy)			and the second s
.			State of the second of the tent of both the second of the
	Dy density (198 cu.m.) (metice 1% (metice 1% (metice)	Somple bits including Somple by	647

22-16" DRUL TATE 1.

GC 71-47

BORING No.			STATION.	3R+ + 29			w.c	2	2-16	4_1	DRIL	د ۵	TE3/	10/71
SURFACE EL	f VAT	1011					DRI	VII:	G W	/EIGI	17	100	124	18 12.
WATER	GRAFHIC SYRPOL	Bucket Au	DESCRIP	nch diam.	tet		GROUP SYNGOL	C.S.C.S.	PENE. RECIST.	CORE O	8AG C	CRY PENSITY per	MCISTURE	RELATIVE CCMPACTION
TH		SILTY 1 S	- 'M; bre	un, moust	, mrdium]		SM		T	1	-	Γ	H
I		5/30% SE:			se grained rect.		F	SP	_					
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:0-										10		97.1	4,5	1
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L 1-1-1]							-			-		<u></u>	

GC 71-48

URFA	CE C	LEVAT	1011							110.	
WATER	OCEPTH FEET	GRAF HC SYNBOL	bucket Augus. 12 sach diameter DESCRIPTION	Savis droad	0.5 c.5	PENE. RESIST	BLUWS/100	94c	CAY GENETTY DO	NOIST URE	RELATIVE
			Filt: SiLTY SAID: SM; brown, moist, medium donse.	٦L	ън					ļ ļ	
_	- 5 -		NATURAL CHOUNT: SAND: SF, tan, coarse grained, moist, medium dense		SP.		-			-	
	-10-		SilvY (MD; 58; brown, moist, skdium derse.		ia H			_			
	\equiv		SAND: SP; ton, coarse grained, dry, section desce. 2. Y (70): 54, brown, toret, downs	E	S P	,	1	D	93.	i	6
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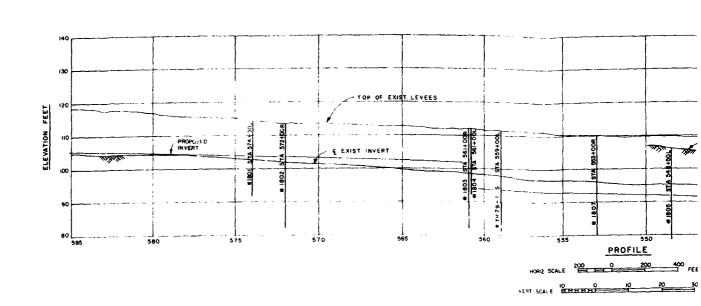
MT64-2

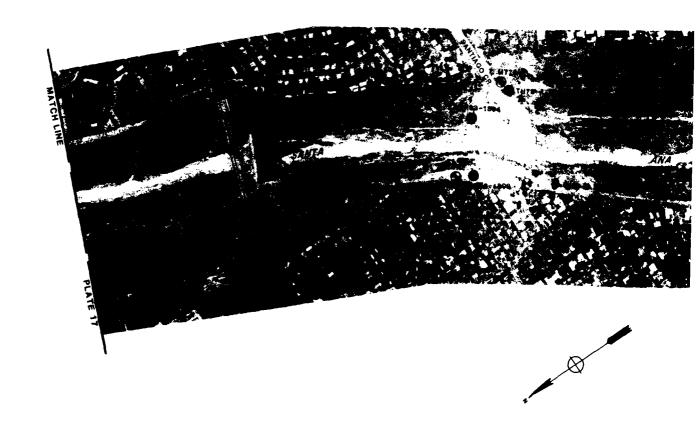
уре	l:" wasiet		Top 14		200 BORING NO. 1 Tevation 1713 Completed to pack
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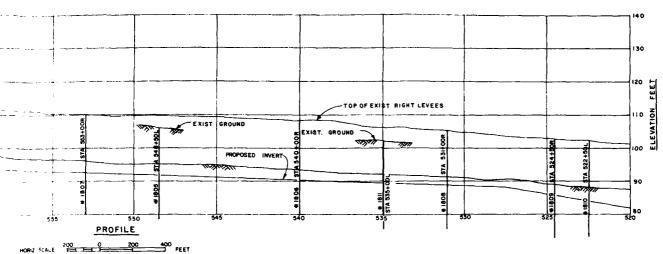
NOTES:

- I. SEE PLATE IT FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

SYMBOL	DESCRIPTIONS	DATE APPROV
	REVISIONS	
		RMY ENGINEER DISTRICT LOS ANGELES RPS OF ENGINEERS
DESIGNED BY	SANTA ANA RIVER MAINS PHASE II GENERAL DESIGN	TEM, CALIFORNIA I MEMORANDUM
DEAWN SY.	LOGS OF INVEST	TIGATION
	BY OTHER	as
GROWN IV.	STA.650+00 TO ST	ra.585+00











NOTES:

- I. SEE PLATE 8 FOR LEGEND AND GENERAL NOTES.
- 2. SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

	IS NATIONAL GEODETIC			
SYMBOL	SSCHPTONS		DATE	MPROVA
	REVIS	ONS		
		U. S. ARMY ENGINEE LOS ANGRIE CORPS OF ENGI	\$	
SERVICE SY,		IVER MAINSTEM, CALIFORN TRAL DESIGN MEMORANDU		
SEAWN SY.	PLAI	N AND PROFILE		
OROSE IN.	STA.585+	-00 TO STA.520+00)	
SUBMITTED BY:	DATE	SPEC. HO. BACWOP-		MEET

TH83-1807

THB3-18	07		ST	A 5534	100 R		EL- 1022				
DEPTH	F06	ж	Ц	PI	4	-200	Ħ	DESCRIPTION			
	SP/SM	2		IР	100	8		SAND/SILTY SAND: TAN, DRY, FINE GRAINED SAND-			
3.0							8	SILTY SAID: TAN, SLIGHTLY DAMP. FINE-GRAINED SAND.			
	98	13		#	100	— <u>19</u>	7	SANE: LIGHT BROWN, FINE GRAINED-			
2.0_	SP/SR	3		187	99			SAND/STLTY SAND: LIGHT TAN, DAND, MEDIUM GRAINED SAND,			
8.0	35	3			93	3		GRAVELLY SAND: MOIST, MEDIUM TO COARSE GRAINED, GRAVEL TO 3 INDES-			
10.0	- PC	21		100	100	50		SANDY STLT: MARK BROWN, MOIST, COMESTVE-			
11-0	SM	22		ИP	100	47		SILTY SAND: DARK BROWN, MOIST, SLIGHTLY COMESIVE.			
12.5	α	22	35	13	100	67		SAMDY CLAY: DARK BROWN, MOIST, COMESTVE-			
14.0	sc	17	32	12	100	49		CLAYEY SAND: BROWN, SLIGHTLY COMESIVE-			
15.5	SM	12		ιφ	190	24		SILTY SAND: BROWN, MOIST, MEDIUM GRAINED-			
16:5		26	43	?0	100	78		SAMBY CLAY: DANK GREY, MOIST, COHESIVE			
		30	\$5	13	190	93		CLAY: LIGHT BROWN, MET, SOFTER-			
W 24	a. 9	25	37	15	109	80		SAMOY (LAY: GRAY-BROWN, LESS PLASTIC-			
		27	42	17	100	38		CLAY: SAME AS ABOVE-			
28.0	ŞĦ	23		φ	100	17		SILTY SMID: SREY, WET, FIME-GRAINED, MON-COHESIVE-			
2											

TH79-1 S

479-1 <			57	4 55 9 +	00 %			ct. 1172
EPTH	Lue	MC .	Ľ.	2;	-4	-200	H	DESCRIPTION
	-							SILTY GRAVELLY SAND- PROMY, MEDIUM DENSE, 99ME PEA-SIZE GRAVEL.
		3		₩0	75	17	p	
	3 H						24	
		_						STUTY SMIN. PROMIN, MOTSY, LYDSE, CHINKS OF CLAY, MIGHLAR GRAVEL TO T. THOM, CONESTON.
		12		•	n	ţn	,	
3-0								
							14	SAMP/SILTY SAME LIGHT BROWN, MOIST, METILIPHOENSE, ANGLER GRAVEL TO \$ TROW, NO CONSTON.
	"" . ሳ ዞ	4		4	44	•		Anna de marco () () () () () () () () () (
1.5							18	
	~	21	30	וי	:*	n	77	SARTY CLAY REGION, HOTER, VERY STIFF, GRAVEL TO 1 INCH.
6.5								
							70	CILTY SAMP. TAN, HOLST, MEDIUM NEMSE, GRAVEL TO 1/2 INCI- CHESION.
	* #	17		1*	:10	ur.		
14.2							18	
								SAMOY D_AY: "NAME BROWN, MOIST, STIFF, POLINTED GRAVEL TO I HINT MAXIMUM (5 PERCENT). CONESSON.
	J.	'!	32	l-	;an	47	9	
25.5								
	0.74	72	76	ς	100	52	17	SAMBY (LAY/SAMBY SILT: SHEV BROWN, HET, COMESTON-
<u># 27.5</u> 28.5 .			٠			,		
30.0	Ç#	23			100	14		TILTY CAUTE GREY WARRING, MET, COMPSION-

TH83-1802

H83-18	02		ST	A 572+	00 R			EL- 114t
DEPTH	1.06	MC	u	PI	4	-200	,	Description
3.5	SW/SM	4		нр	n	11	ע	GRACLLY SAND/SILTY GRAVELLY SAND: BROWN, MOIST, FIN TO MEDIUM GRAINED SAND.
2.3	SP/SH	3		₩	99	9	8	SAND/SILTY SAND: BROWN, MOIST, MEDIUM GRAINED SAND-
6-0 7-0	W.	16	57	9	100	65		SANDY SILT: WAN, MOIST, FINE GRAINED SNC, SLIGHT COM
9.0	SM	6		NР	100	20	8	SILTY SAND: LIGHT BROWN, MOIST, SLIGHT CONESION-
10.5	SP/SM	4		*	100	6	9	SAMO/SILTY SAMO: LIGHT BROWN-TAN, MEDIUM GRAINED.
		17	28	ę	190	58		SAMEN CLAY: BROWN, MOIST, SLIGHT COMESION.
	CL	20	40	25	100	82		SAME: DARK BROWN-
	•	16	28	13	100	52		SAFE: GREY-BROWN-
		18	ķņ	11	190	- 51		SAME: PROM-
21-0		25	49	24	100	98		CLAY: BROWN, MOTST, COMESTVE-
	SW/SF	14	22	5	100	42	11	SILTY SANTI/CLAYEY SANT); PROM, MOIST, FINE SPAINED
24:0		24.	30		.100	75		SMINY CLAY: BROWN, MOIST, CONESIVE-
<u>n 27.</u>	n 1	27	۱	14	1117	76	8	
28 :0	SMVSC	15	23		130	41	26	SILTY SAND/CLAYEY SAND: BROWN, MOIST, FINE GRAIMET
50-0 31-5	SP/SM	15			130	10	- 21	SAHD/SILTY SAND: BROWN, MOIST, MEDIUM GRAINED SAND

TH83-1803

1435-18	03		171	561	Où B			EL- 112:
NEPTH	LOG	M (i.	P;	-4	-200	4	DESCRIPTION
	SM	5		ψ.	79	31		GRAVELLY SILTY SAND: GROWN, MOIST-
1.5	<u> 2642</u>	3		Æ	:05	4		SAND/STETY SAND. TAN, DAY, MEDITAL GRAINED SAND.
2-5 4-0	n.	15		*	1,4	5 <u>5</u>	16	SANDY SILT: BROWN, MOIST, COMESIVE, FINE GRAINET S
	26	,			γ:	1	9	SAND: LIGHT BROWN, MOIST, NON-CONESIVE, MEDI M SAN SAND-
5.5	SP/SM	4	23		# + [10]	٠,	1	SAND/STLTY SAND. GRAY, MOIST, NOM-COMESIVE, FINE S SAND.
_9.C 10.5	ъ. 				7:	4	3	SMID. GRAY, HOIST, NON-CONFSIVE, MEDIUM GRAINED S
TU:-2		??	41	į.	13	*9		SANDY CLAY: BROWN-GREY, MOIST, COMESIVE.
		23	ųt	7.		3t	22	FLAY: DARK BROWN.
	Ĵ	21	44	24	137	35		SAME PROMP-
		19				7	17	SAMIY CLAY: MRCHIN.
		38	44	21	13	àυ		CLAY- RACHAN-GREY.
14.5		IJ.		. 15	D.	7.15	14	SAMTY PLAY: YELL THE BROWN, MITTER
	ÇH	45	51	26	* 4	àr		
. بنوند								
	a.	72	13	1.	(a)		11	SAMPY FLAY: FRAK BROWN, MOIST, SLIGHTLY PLASTIC
24:0	5 47	<u>7</u> 1`		y	17	· 46	u	STETY SAID: BROWN, HOIST, SLIGHTLY CONESIVE.
25.0_	<u>a</u>	29	44		D:	3 6		CLAY: BROWN, MOIST, COMESTIVE, SLIGHTLY PLASTIC-
22:0.		70	55		াদ	₩.	-	TILT: MONN, MOIST, COMESTVE, SLIGHTLY PLASTIC-
28 G	- 18 7A		78		- 130			SARTY STLY/SARTY CLAY: MODEL, MOIST, CONESTVE-
29.0			60		100	া সুচ	-	TAY- MONTHEY, MOIST, CONESIVE, PLASTIC-
30.0.							-	

TH83-1802

EL. 1142 -200 N DESCRIPTION GRAPELY SAMO/SILTY GRAVELY SAMD: BROWN, MOIST, FI TO HEDIUM GRAINED SAMO. 11 17 8 SAMO/SILTY SAMD: BROWN, MOIST, MEDIUM GRAINED SAMO. 55 SEMOY SILT: New, MOIST, KINE GRAINED SAMO, SLIGHT COM- 9 SILTY SAMP: LIGHT BROWN TAN, MEDIUM GRAINED. 58 58 58 58 58 58	
######################################	
11 17 18 SMO/SILTY SMID: BROWN, MOIST, MEDIUM GRAINED SAND- 55 SERVI SILT, New, Moist, Sim Grained SMD, SLIGHT COM 20 8 SILTY SMID: LIGHT SHOWN, MOIST, SLIGHT COMESION- 58 SMO/SILTY SMID: LIGHT BROWNTAN, MEDIUM GRAINED. 9 SMOYSILTY SMID: LIGHT BROWNTAN, MEDIUM GRAINED. 58	
9 8 SMOVSILTY SMO: BROWN, MOIST, MEDIUM GRAINED SMOO- 65 9 SMOVSILT; BRN. MOIST, FIRE GRAINED SMO, SLIGHT COM- 20 8 SILTY SAMP: LIGHT ROOM, MOIST, SLIGHT COMESION. 6 9 SMOVSILTY SAMP: LIGHT BROWN TAY, NEDIUM GRAINED. 58 58	
9 58 SMENT SILT: New, MOTEY, FINE GRAINED SMED, SLIGHT COM- 20 9 SILTY SAMP: LIGHT RACHA, MOTEY, SLIGHT COMESTON- 5 SMED/SILTY SAMP: LIGHT BROWN TAN, NEDTUM GRAINED. 9 SAMEN CLAY: RECEN. MOTEY, SLIGHT COMESTON- 58	
20 8 SELTY SAMP: 1.16+T BROWN, MOIST, SLIGHT COMESION- 6 9 SAMPLY SLAMP: LIGHT BROWN TAW, MEDIUM GRAIMED. 58 SAMPLY CLAY: "ROWN, MOIST, SLIGHT COMESION.	ESION.
5 SWIVSLITY SAMP: LIGHT BROWN TAN, NEDIUM GRAINED. 5 SWIVSLITY SAMP: LIGHT BROWN TAN, NEDIUM GRAINED. 58 SWEW CLAY: "ROWN, NOIST, SLIGHT CONESION.	
9 SMEY CLAY: Rhow, HC15T, SLIGHT CONESION-	
58	
·	
SAME: TARK BROWN. 32	
SAME: SAEY-BROWN.	
5T SAFE: PROM-	
98 (LAY: RACHA, MOTOT, CHERTHE.	
11 SILTY SMITH, SYTY SAY RETHE, MOIST, FINE GRAINED 42	SMC.
ZE SHIPP (CAY SPOOK), MILEY CONESIVE.	
76 8	
41 SILTY SAMPY CLAYER TAND RESMY, MOIST, FINE GRAINED	SAD.
10 SAND/SILTY SAND RACHA MOIST, MEDIUM GRAINED SAND-	

TH83-1803

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	-270	•	1.00
٠:	"1		SPANE Y TO THE CAN'T SPONN, MOIST.
			SMITTER THE THE TOWN WEDLIN GPAINED SAND
	<u>55</u>	1:	SMOV CL. * SHOWN MOSTS COMESTVE, FINE GRASHED SAND-
	*	7	CAND LIGHT RESIDE MILEST, WON CONCESSIVE, TEDLEM GRAIMED SAME.
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í.		•	DRIT HAY, MI, I WINTERPROTE MEDICAL GRAINED SAND-
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	86	27	CM Cap Janes
5 .1	85		WE ROSA
y	79	17	SARTY CAY POYME
	ar.		Tight Remark Surviv
Ψ.		, tt	THE TELESCOPE WITH THE TELESCOPE THE TELESCO
	ЭŔ		
e,	17	11	THE LAY DECIMENT METERS, SUIGHTLY PLASTIC.
ন্	· · 35 -	11	STOW THE SHOWN, HOUSE, SLIGHTLY CONESIVE.
מר	34		TAY SOME TOIST COMESTVE, SLIGHTLY PLASTIC-
	· · · · · · · · · · · · · · · · · · ·		TT Sense, Spist, consider, Sciently Austric-
T	<u>ā</u> .		THE THE PARTY PLAY THOMAN, MOIST, COMESTVE
	····		TAY MINE THEY, MIST, COMESTVE, MARTIC.

TH83-1801

THB3-18	301		\$1	A 574	+00 L		FL- 114s				
DEPTH	L06	MC	u	PĮ	-4	-200	H	DESCRIPTION			
	98	2		MP.	90	17		SILTY SAND: GREY, DRY, SOME ORGANIC MATERIAL, GRAVEL TO 3 INCHES, COMPSE GRAINED SAND.			
2.5							18				
		9	28	9	100	42	-	CLAYEY SAND: BROWN, MOIST, MON-COMESIVE, FINE GRAINED SAND.			
	SC	16	23	9	100	42	11				
6.0											
								SAMDY SILT: BROWN, MOIST, COMESIVE-			
	**	29	63	13	100	84					
0.0	ML/IL	20	25	5	100	72		SAMBY SILT/SAMBY (LAY: BROWN, MOIST, NON-CONESIVE-			
2.0	α-	23	33	11	100	-67		SAMPLY ILAY: BROWN, MOIST, SLIGHTLY CONESIVE-			
3.0		23		HD.	190	 29		SILTY SAND: Becom-GREY, MOIST, NON-CONESIVE-			
5.0	31	.,			LUJ	ξ3		STOTE SHALL DECIME ONCE, PARTY MAN CONCESTAGE			
		31	33	8	100	52		SAMOY SILT: BROWN, MOIST, COMESIVE-			
								SAME: BROWN-GREY.			
		26	33	4	100	52					
	M.							SAME: GREY-			
		33	33	8	190	52					
		 29	39	11	100	96		SILT: Broker-Skey.			

TH83-1804

THB3-18	134		\$7	4 561	+30 l			FL- 11/22
DEPTH	L09	#¢	LL.	ρį	-4	-200	н	DESCRIPTION
1.0		. 3	32	10		40		CLAYEY SAMD: LIGHT BROWN, DAMP, FINE GRAINED SAND. ROOTS ANT GLASS FIRST 5 INCHES:
		13	41	21	100	65	18	SANDY CLAY: BROWN, MOIST, SUIGHTLY COMESTVE, FINE GRAINED.
	CL	η	323		100	77		SAME: THANK BROWN AND LIGHT BROWN LENS-
4.5							1!	
	Mi.	52	5 5	?5	100	90		SILT - PROMIN, MOIST, SLIGHTLY COMESIVE.
2.0		-15	30	- 5	100			SHOY STLT: LET BAN, MOIST, FINE STAINED SHO, SLIGHTLY COM-
	4	19		NР	100	70		SAME: BROWN-
10.0			30		100	70		SAMITY CLAY: BROWN GREY, CONESIVE, TIME GRAINED SAME-
11.0								SILTY SANT: Region, MOIST, NON-COMESIVE-
	34	15		*	100	रह	16	
14.5								
H_16-0	ď	50	30	10	1073	87		SAMPY PLAY: RECHIN. MOIST, COMESIVE-
	S#	۱5	25	4	130	37		STEIN SAND: SREY, MET, COMESTVE-
19-0 20-0			35	70	100	72		SAMY STL. BROWN GREY, SLIGHTLY COMES IVE.

SCALE I NO 3FT

NOTES

- 1 SEE PLATE 18 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT"

SYMBOL	DESCRIPTIONS		DATE	AFFECVA					
	REVISIO	ONS							
		U. S. ARMY ENGL LOS AND CORPE OF E	SELES	icī					
DESIGNED BY:		IVER MAINSTEM, CALII RAL DESIGN MEMORA							
DEAWN ST.	LOGS OF	NVESTIGATIO	NS						
CHICARD 9%	CORPS	OF ENGINEERS	S						
į į	STA.574+00 TO STA.553+00								

TH83-1805

THB3-1	805			TA 54	8+50 L			EL- 1062
DEPTH	L06	MC	u	PŢ	-4	-200	N	DESCRIPTION
	ML/QL	14	29	,	100	54	8	SAMOY SILT/SAMOY CLAY: BROWN, MOIST, FIME TO MEDIUM GRAINED SAMO, ORGANIC MATERIAL.
1.0							8	
	CH	24	54	30	100	83	٠	SANDY CLAY: DARK BROWN, MOIST, SLIGHTLY PLASTIC-
6.0								CHINA CLASS TO THE CONTRACT OF
		77	- #	- 24	100	79		SAMDY CLAY: DANK BROWN, MOIST, SLIGHTLY PLASTIC- SAME: LIGHT BROWN, MOIST, FIME GRAINED SAME-
		12	31	12	100	73		SHIC: Clari SHOW, HUIST, FINE GRACINED SHOP.
		_					12	
		18	45	26	100	85	_	C. Y: GREY-BROWN, MOIST, SLIGHTLY CONESIVE-
	α	17	37	19	100	76	21	SAMON CLAY: GREY-BROWN, MOIST, SLIGHTLY COMESTIVE
		23	32	10	100	69	13	
		24	32	9	100	65	_	
20-0	sc	17	75	8	100	48	9	CLAYEY SAND: BROWN-GREY, MOIST, COMESIVE-
	<u> </u>	17		- 6	93	74		
3	37/31	15		-7	71	-11	10	SILTY SAND: BROWN, MET, SOME GRAVEL I INCH-
	PL.	28		· ·	100	50		SAVE SILE BROWN, MET, SLIGHTLY COMESTVE, MEDIUM GRAINES
0	SP/SH	22	29	2	93	. 11	19	SAMPASILTY SAMPA. SPORAL STREET
		21		NP.	100		,,,	SMD/SILTY SMD: BROWN, NET, MEDIUM GRAINED SAND.
	24	22		100	100	40		SILTY SAMD: DANK GREY, NET, FINE GRAINED SAND- SAME: BROWN-

TH83-1806

EL- 1082			+00 R	TA 540	\$		06	THB3-18
DESCRIPTION	H	-200	4	Pį	LL	MC	L0G	DEPTH
SILTY SAND: LIGHT BROWN, MOIST, HON-C							_	
		14	98	#P		4	34	
	38							3.5
SMOY SILT: BROWN, MOIST, SLIGHTLY CO	12	69	100	14	41	22	M,	_6-0
STLTY SAID: LIGHT BROWN, MOTST, NON-C		31	99	¥		3	SY	7.0
	8							
SANDY CLAY: BROWN-RUST, MISST, COMPSI		70	100	16	35	21	a_	
CILTY SANT: BROWN, FINE GRAINED SAND	31	17	97	160		4	- 51	9.5
GRAWILLY SAMO/STLTY GRAWITY CHIN.	•		70	YP		7	क्राक्र	10.5
SAMOY DLAY: DARK BROWN, MOIST, SLIGHT					_			11.5
COHES I VE	9	61	100	n	40	27	Q.	13-0
SILTY SANT: TARK BROWN, MOIST, SLIGHT COMESTVE-		73	99	*		3	SM	14.5
CLAY: DARK BROWN, YOIST, COMESIVE.		87	100	12	34	23	α	15.5
STLTY: DARK BROWN, HOIST, CONESIVE-		86	100	12	46	24	٩	17:0
SMOY CLAY: "ARK BROWN-GREY, HOIST, C						21.		
	12		100	23	49_	24_	۵	
	12	79	100	20	43	24	~	
						-		
								22.3
SILTY SATE: BROWN-GREY, WET, OLIGHTLY		48	190	40		[9	34	24-0
CUT. Dec.				_				24.9
STUT: DARK MICHIN, WET, COHESTVE-	9	99	10n	21	59	33	**	26.0
		.,		••		•	-	
								8-0
SANDY CLAY: DARK GREY-BROWN, -ET. CO-		78	100	19	42	29	a.	
								0.0

TH83-1806

\$1	A 540	+00 R			EL - 1982
i.	PĮ	4	-200	,	DESCRIPTION
			_		SILTY SAND: LIGHT BROWN, MOIST, NON-COMESIVE-
	₩.	98	l#		
				38	
41	14	100	59	12	SMIDY SE.* BROWN, MOIST, SLIGHTLY CONESIVE-
	*	99	31		STUTY SAME LIGHT BROWN, MOIST, MON-COMESIVE-
				8	SANTY TLAY BROWN-RUST, MINIST, COMPSIVE
36	16	190	70		Sec. Ca. Grown 10317 PP1217 COR SIVE
	φ	97	17	31	CT TV CAN" BROWN, FINE GRAINED SAND.
	*	70	5		MANELY SMED. COARSE GRAINED SMED. LIGHT BROWN, COARSE GRAINED SMED.
40	2?	100	61	_	GRANET SAME. SAME STATE TO NON-CONESTIVE TO NON-CONESTIVE TO NON-CONESTIVE.
	-	2	73	9	STORY SMITH THANK BROWN, MOIST, SLIGHTLY CONESTIVE TO HON-CONESTIVE.
34	12	100	87		TANK BROWN, MOIST, COMESTIVE-
46	12	100	36		SILTY: "NARE BROWN, MOIST, CONESIVE-
44	23	100	77		SMETY CLEY: "MAK BROWN-GREY, MOIST, COHESIVE-
				12	
43	22	100	.79	_	
	₩	100	48		SI ** SAY" ROMEGREY, NET, SLIGHTLY CONESIVE-
69	21	100	39	9	CLT FAR MODAL, WET, CONESTVE:
42	15	170	79		SAMPY FLEY DARK GREY-BROWN, WET, COMESTVE, PLASTIC-

TH83-1811

TH83-18	11		\$1	A 535	•00 L			£L. 102±		
DEPTH	106	#¢	LL	PŢ	-4	-200	N	DESCRIPTION		
1.0		8_		JP	100	26		STLTY SAND: BROWN, MOIST, MON-COMESTVE, MEDIUM GRAINEI SAND, ORGANIC MATERIAL.		
	SP/SM	5		W	100	10	16	SAND/SILTY SAND: GREY, MOIST, MEDIUM GRAINED SAND, NO COMESIVE-		
4.0					90		24	SAMT: GRAY, MOIST, COARSE GRAINED SAMD		
	%						18			
		ų			100	4	-	SAME: SRAVEL 1/2 INCHES DIAMETER-		
0.0		19	48	27	100	84	29	SANDY CLAY: BROWN, MOIST, SLIGHTLY COMESIVE-		
		27					12	SME: GREY-BROWN, CONESIVE-		
115.5		25						SAME: DANK BROWN-		
	α	26					13	SAME: RACHA-		
		Þς	77	9	100	55				
		57	12	19	100	30		SAME - TANK BROWN, WET-		
		372	34	17	100	88	7	FLAY- BARK GREY, WET, COMESIVE-		
6-0		33	t g	17	100	88	10			

SCALE I IN-3FT

NOTES.

- I SEE PLATE IS FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE SA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE MOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

PHINOL DESCRIPTIONS U. S. ARMY ENGINEER DISTRICT LOS ANGELS ORRES OF ENGINEERS SANTA ANA RIVER MAINSTEIN CALIFORNIA PHASE II GENERAL DESIGN MEMORIANUM LOGS OF INVESTIGATIONS CORPS OF ENGINEERS OSCIONE ON STA.548+50 TO STA.535+00 SAMMITTED BY: DATE APPROVED. SHEET PLE NO.

TH83-1808

TH83-1	908		S	TA 53	1+00 R			EL. 1052
DEPTH	L06	MÇ	ш	PI	4	-200	N	DESCRIPTION
		3	_		98	4	18	SAND: TAN, DRY TO MOIST, MEDIUM GRAINED SAND, HON- CONESIVE-
		3			98	4	5	SAME: MOIST-
6-0 5-5	SI	_10_		•	100			SILTY SAND: LIGHT MOON, MOIST, FIRE GRAINED SAND
	39	8			99	4	7	SAND: TAN, MOIST, FINE TO MED. GRAINED SAND, NON-CONESIVE
9-0	sc	20	46	25	100	50	17	CLAYEY SAND: DARK BROWN, MOIST, FIRM-
	SM	5		ИP	100	19		SILTY SAND: GREY, MOISY, SLIGHTLY COHESIVE.
1.0	a	-19	31	15	100	53	10	SAMOY CLAY: DARK BROWN, MOISY, SOME COMESION.
5.5	SM/SC	#	24	7	190	42	9	SILTY SAMP/CLAYEY SAMP: DARK BROWN, MOIST, SOME COMESION- SAME: BROWN, WET-
		25	ul.	24	100	91	3	SAMITY CLAY: RECOM, MET, PLASTIC ORGANIC MATERIAL.
	Ţ	75					11	SAPE: GREY-DARK BROWN-
2.0		25						
							9	SANTY SILT: BROWN-GREY, NET, PLASTIC-
	4	23	55	4	100	56	9	
·.a								
.2	2	21	29	14	100	57		SAMMY (LAY: SQUE-GREY, WET, PLASTIC-
.0	<u> </u>	?1		100	190	<u> </u>		SILTY SANT, GREY, WET, PLASTIC-

TH83-1809

TH83-1	809			STA 521	₩50 R			EL : 103±
DEPTH	L06	нс	u	PI	-4	-200	*	DESCRIPTION
		5		NP	95	23	38	SILTY SAMD: SROWN, MOIST, COMMLES T
	5%	9		_ NP	100	25	13	SAME: FINE GRAINED SAND-
		8		NP	190	26		SAME: LIGHT BROWN-
23	57/57			- 10	100			SAMP/SILTY SAMP: LIGHT BROWN, MOIST
8.0	58	13		. HP	100		9	SILTY SAND: "ARK BROWN, MOLST, SOME
10.5	٩	32	48	19	100	77	8	SAMDY STLT: DANK BROWN, MOTST, COME
		12	26	3	190	40	٠	CLAYEY SAND: DARK BROWN, MOIST, CON
	SC	17					10	
15.5 15.0	_1	34	- 47	16	100			SANDY SILT: GREY-BROWN, MOIST, COHE
17-0	SMVSC	- 73	27	5	100	7 <u>5</u> 33	9	STILTY SAND/CLAYEY SAND: DARK BROWN.
18.5	N /0.	28	27	6	110	73		SANDY SILT/SANDY CLAY: DARK GREY, W
		26	52	15	100	72	8	SANTY CLAY: PROMIN MET, SLIGHTLY PL
		\overline{r}	45	25	100	72	8	SAME: "MARK GREY, WET, PLASTIC.
	α	30					10	
		3?						
30.0								

TH83-1809

### 171 13 SILT SAVE. TARK BROWN, MOIST, SOME COMESION. 19 121 72	19	-4	-290	*	DESCRIPTION
SAFE LIGHT SPONN.	нP	45	23	38	SICTY SAMP ROWN, MOIST, COMMLES TO 4 INCHES-
## 13 25 ## 13 5 ## 10 15 5	IP.	্ল	- 3	13	SAME. FINE GRAINED SAMD-
## 20 13 SILT CAP. TAR. BROWN. MOIST, COMESION. SAMIN DIT TARK BROWN. MOIST, COMESION. 19 13 TO 40 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 22 TARK BROWN. MOIST, COMESIVE. 23 TO 40 TARK BROWN. MOIST, COMESIVE. 24 TARK BROWN. MOIST, COMESIVE. 25 TARK BROWN. MOIST, COMESIVE. 26 TARK BROWN. MOIST, COMESIVE. 27 TARK BROWN. MOIST, COMESIVE. 28 TARK BROWN. MOIST, COMESIVE. 29 TARK BROWN. MOIST, COMESIVE. 20 TARK BROWN. MOIST, COMESIVE. 20 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 22 TARK BROWN. MOIST, COMESIVE. 23 TARK BROWN. MOIST, COMESIVE. 24 TARK BROWN. MOIST, COMESIVE. 25 TARK BROWN. MOIST, COMESIVE. 26 TARK BROWN. MOIST, COMESIVE. 26 TARK BROWN. MOIST, COMESIVE. 26 TARK BROWN. MOIST, COMESIVE. 27 TARK BROWN. MOIST, COMESIVE. 28 TARK BROWN. MOIST, COMESIVE. 29 TARK BROWN. MOIST, COMESIVE. 20 TARK BROWN. MOIST, COMESIVE. 20 TARK BROWN. MOIST, COMESIVE. 20 TARK BROWN. MOIST, COMESIVE. 20 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 22 TARK BROWN. MOIST, COMESIVE. 23 TARK BROWN. MOIST, COMESIVE. 24 TARK BROWN. MOIST, COMESIVE. 25 TARK BROWN. MOIST, COMESIVE. 26 TARK BROWN. MOIST, COMESIVE. 26 TARK BROWN. MOIST, COMESIVE. 27 TARK BROWN. MOIST, COMESIVE. 28 TARK BROWN. MOIST, COMESIVE. 29 TARK BROWN. MOIST, COMESIVE. 20 TARK BROWN. MOIST, COMESIVE. 20 TARK BROWN. MOIST, COMESIVE. 20 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 21 TARK BROWN. MOIST, COMESIVE. 22 TARK BROWN. MOIST, COMESIVE. 23 TARK BROWN. MOIST, COMESIVE. 24 TARK BROWN. MOIST, COMESIVE. 25 TARK BROWN. MOIST, COMESIVE. 26 TARK BROWN. MOIST, COMESIVE. 26 TARK BROWN. MOIST, COMESIVE. 27 TA	Ψ	ix	26		SAME (LIGHT SROWN-
SAMPY TARK BROWN, MOIST, COMESION-	_			3	SAMP SILTY JAMP TO BROWN HOLST, COMESE GRAINED SAM
3 170 40 121 142 SACHE TARK SACHER, MOIST, CHESSIVE. 5 17					
SANTY 1 SANTY 1.3Y PARK GREY, MET, PLASTIC. 5 100 19 19 19 19 19 19 19 19 19 19 19 19 19	3	:º:	46	9	TIMEN SAME SACHAN, MOIST, CONESSIVE
SAMPLE TO SAMPLE TO SAMPLE DAME GREEN HET PLASTICE SIGNATULE SPENNING HET SLIGHTLY PLASTICE SIGNATULE SPENNING HET SLIGHTLY PLASTICE SIGNATULE SPENNING HET SLIGHTLY PLASTICE SIGNATULE SPENING HET SLIGHTLY PLASTICE SIGNATULE SPENING HET SPENING HET SLIGHTLY PLASTICE SIGNATULE SPENING HET				::	
5 GANTY D. 11 PROMAL MET, SUIGHTLY PLASTIC. 5 DY 19	5	3	- 1	3	AND JAPE BROWN POIST COMESTVE
5 17 19 	ń	He	ۋە		SAMTY TO SAMEY TOLEY - CARK GREY, HET, PLASTIC
	ń	177	°q	8	CARTY I. T. PROMI. HET, SLICHTLY PLASTIC.
and the second of the company of	5	ix:	77	9	UMF TARK (MEN. HET PLASTIC)
P				17	

TH83-1810

THB3-18	310			TA 52:	2+50 L			FL- 102±
DEPTH	L06	MC	u.	PI	-4	-20n	N	DESCRIPTION
				MP.	96	23		SILTY SAMD: RROWN, SLIGHTLY MOIST.
		_		φ	99	15		SAPE: LIGHT BROWN, NON-COMESSION-
	274	5		NP	95	22	6	SAME: PROKEN A/C AND CONCRETE, MOIST.
8.0		5		МÞ	96	17	10	SAME: GRAVEL TO 2 INCHES.
0.0	n.	29	1 88	29	100	86		CLAY: DARK BROWN-GREY, MOIST, CONESIVE-
1.0	SH	27		Ψp	100	43	8	STUTY CAND. B
		20		NP	100	51		SILTY SAND: DARK BROWN, MOIST, COMESIVE. SANDY SILY: DARK GREY, MOIST, COMESIVE.
		19						SAME: PARK BROWN.
	۹.	23	\$7	5	100	77		SAME - DARK SREY.
1.0		31	47	13	100	78		
		51	4E	74	100	76		SAMOY CLAY. GRAY, MET.
	c							
		_						
		34						
.0								

NOTES

- SEE PLATE IN FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE

SCALE I IN-3FT

SYMBOL	SESCRETIONS		DATE	APPROV				
	REVISIO	NS .						
		U, S. ARMY ENG LOS AN CORPS OF E	GELES	CI				
OFSIGNED BY		ER MAINSTEM, CALI AL DESIGN MEMORA						
DRAWN SY.	LOGS OF INVESTIGATIONS							
	CORPS	OF ENGINEERS	3					
CHICAGO Ph	\$TA.531+0	00 TO STA.522	+ 00					
SUBMITTED BY:	DATE	SPEC. NO. DACWOF-		\$1400				

MT78-4

MOORE & TABER CONSULTING ENGINEERS AND GEOLOGISTS

	2.5	t	-	_		10.6	PRING LOG
TYPE	16"	Bucket	Augs	"-	7 1	57	Sport fine SILTY SAND
	98	11.1	1 2.	5 1			SILT lenses
		p.8.	1 2.	.5 2	311		
	110	17.5	3 2.	.5 ,	15	, <u>marks</u>	Grav-green CLAVFY SILT with oxidation streaks
	101	24.1	1 2	.5	20		less CLAY - some fine SAND
					,,		SAN seams
1	77. 9×	26.	2 2	1			Creen-brown fine SILTY SAND
1	۵,	37.6	1 2	. 5 6	"	M.	
							NotES: 11 No rawing 21 proporties at 23 feet 17 hours wise drilling.
1							
				-		$\ $	
			İ				
						L	
		100			! !	9	THIS BORING LOG SUMMART APPLIES ONLY AT THE THE AND LOCATION INDICATED. SUSSIAFACE COMBITION MAY DIFFER AT OTHER LOCATIONS AND TIMES
190	197		113	- 3	8	11	LOGGED BY 114 DATE 4 27 TE

MT 78-5

27.2 Elevation
1 24.1

TEST BORING LOG

CLEVATION 1::- DORNS 5

ST. GRANGE IN 1::- DORNS 5

CLEVATION 1::- DORNS 5

ST. GRANGE IN 1::- ST. ST. SAB With 1::- ST. SAB WITH 1::- ST. The state of the s

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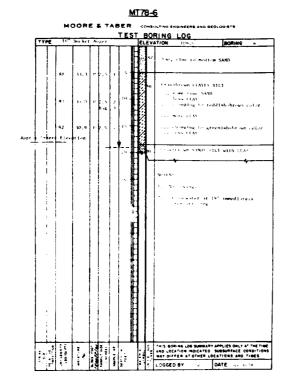
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Br - 20	C N.	32	STAPON 253 + 21	WO 22 164 DRILL DATE 3/1-411
		LEVAT		DRIVING WEIGHT 1500 15. 15
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			37.59 of 5 SM, blave, moret,]- 3h
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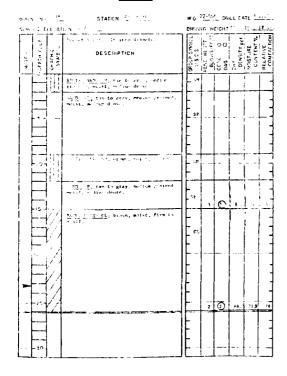
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DATE



GC71-36 W.O. 22-164 DRILL DATE 3/11/71 STATION 276 + 18 BORING No 36 DRIVING WEIGHT 150 - 15 .. 18 in. SURFACE ELEVATION 101 GROUP SYNGOL U.S.C.S. PEUE RESST. GUNEST COPE COPE O COPE O COPE O CONTENT OF ROLATIVE COMPACTION WATER OCENTH FEET Sucker auger: 16 inch diameter Silly Salar My breve, soust, medaum dence. SAUD: CP; tan, moist, medium dense. --5 1 10 102.0 2.6 92 -10-2 1 Silly : No: SM: brown, moist, medic L 15 SINGN SELT: M. brown, roist, fire. STLTY SMO: SM: brown, moist, medium -20

GC 71-38



NOTES:

- I. SEE PLATE 18 FOR TEST SITE LOCATIONS
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

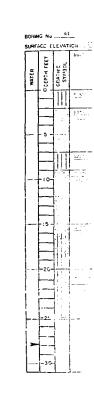
STMBCIL	INSCHINGS.	DATE	APPROVI						
	REVISIONS								
	U	S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS							
DESIGNED ST.	SANTA ANA RIVER I PHASE II GENERAL I	IAINSTEM, CALIFORNIA ESIGN MEMORANDUM							
SEAWN SY.	LOGS OF INVESTIGATION								
	BY O	THERS							
08089 M									
	STA.585+00	TO STA.520+00							
BUBMITTED BY:	DATE AFFROVED: SPEC.	NO. DACWOP B	\$1400						

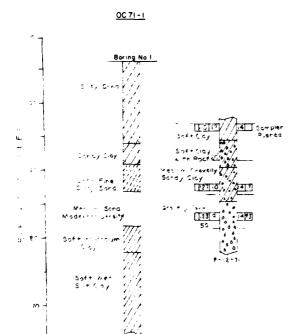
GC 71-39

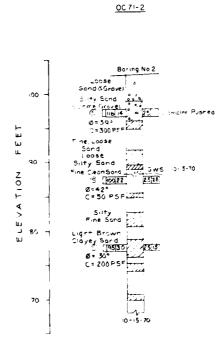
BORIE	NG No.	39	<u></u>	STATE	ON	1 + 28			W.O.								
SURF	ACE E	LEVAT	10N 48	-					DRIV	NG	WE	GH	r .!!	500	15.	_	18 1
WATER	ODEPTH FEET	GRAFHIC SYMBOL	Bucket Ac	ger t	6 inch		er.		GROUP SYNEOL	PENE. RESIST.	BLOWS/FOOT	200	DRY	CENSITY pot	MOSTURE	CONTENT %	RELATIVE
	-		SILTY SAY Jense	<u>: 54</u> :	brown,	muist,	ned tum		- sn								_
	- 5 -		SAND SP. grained,	noist,	grav, medium	medium dense.	i in coa	rse	P SP								
-	-10-	TEY										O	9		5.	3	1)
	-15 -		<u>anr</u> sa de⇒a						5M		+						-
	-20-		1.4%	1.11.				_	HL	Ŀ	1	Ö	E		13.		. 4
			<u> </u>						F.,							1	
			a	ese nº		- Jac			- - -	-				· ·		-	-
	-20		L							-	1	_	-	_		+	_

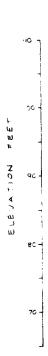
GC71-40

	16 No _5		W 0. 27-161 DRILL DATE J-11-11
SURF	ACE ELEV	ATION _1.2	DRIVERY WEIGHT 1000 15. 18 in.
WATER	OCEPTH FEET GRAPHIC	Bucket Auger 16 inch diameter. DESCRIPTION	PRIDE SWILD 1-8 CSWILD 1-8 CSWILD 2 CSWILD CSWILD CSWILD CONTRIFT CONTRIFT CONTRIFT CONTRIFT CONTRIFT CONTRIFT CONTRICT
		FILL SHAY SAND IN: Fraum, folse, residum dens.	
	- 5	MATERY GOVERN STOP MP. Co. Co. Co. Co. Co. Co. Co. Co. Co. Co	54
-	-10		(S) (S4.5) (C. 40)
	-15	Shari Chin C. Brown	
	-50-	AND THE RESIDENCE OF THE PARTY	3 50 50 50
-24		State in the second of the sec	
	-30-		le Hid

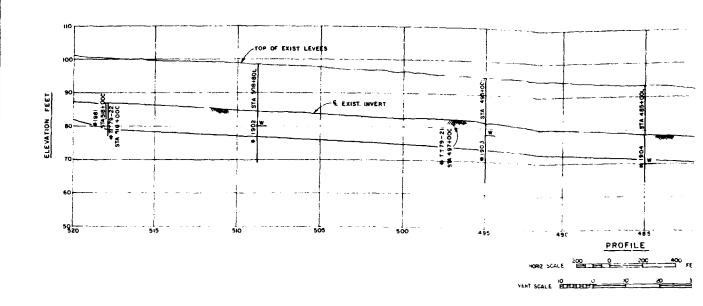


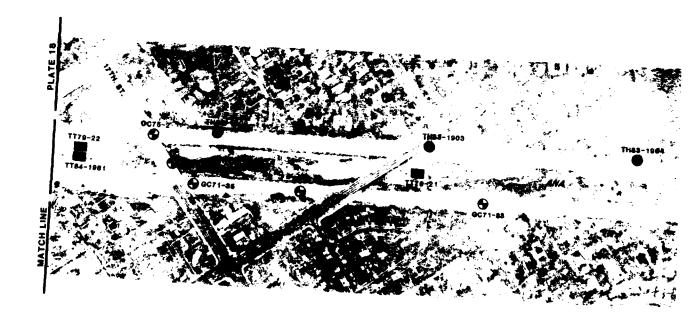




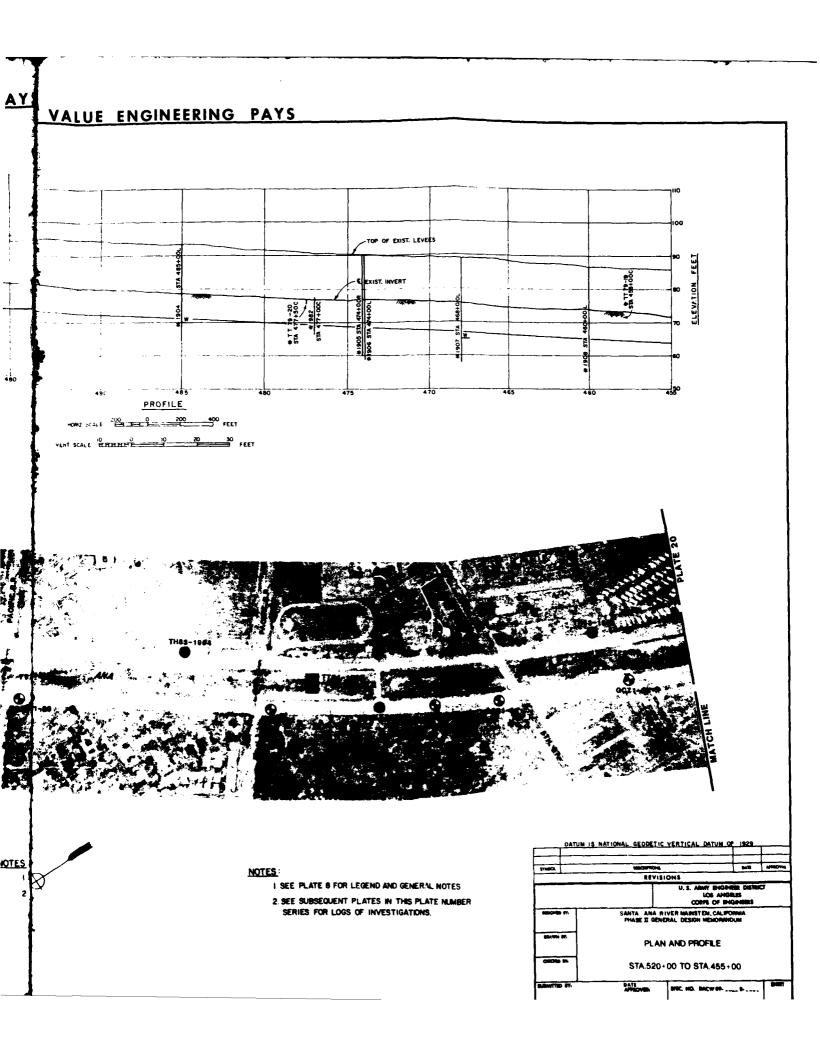


STA:585+00 TO STA:520+00









7784-13		ERT	SI	4 - 1981 EL : 975				
DEPTH	L06	MC	ш	PI	-4	-200	N	DESCRIPTION
	39/38			w	100	9		SAND/SILTY SAND: LIGHT BROWN, MOIST TO MET, FINE GRAINED SAND-
3.0 4.0	3H 3P		35	3	100	43		SILTY SMID: GREY BLACK, MOIST TO WET, FINE GRAINED SAND, SOME ORGANIC MATERIAL. SMID: LT BRH-GREY, MOIST TO WET, FINE TO MED. GRAINED SAND SOME GRAPE, 18-3 INDIES. SOME CORBUS TO 8 INDIES.

-22	<u> 1179-22</u>								
6 87			00 E	-2? 518+0					
NESCRIP	н	-200	-4	PI	ш	HC	L06	DEPTH	
GRAVELLY SAVID: GREY, MOIST, OCCASIONAL BOULTERS TO 74-IN		3	59			4	ф	2.0	
SANDY (LAY: BROWN, WET, CON		86	100	2?	44	32			
		57	100	13	31	26	σ		
SAME: BROWN, HET, COMESIVE.		58	100	12	31	2.7		10-0	

483-190	15		2,	1 495	*01) (E1 95±
MEPTH .	L16	*(u	PĮ	-4	-200	4	DESCRIPTION
2.6	S#	3		*	91	22		SILTY SAMT: LIGHT BROWN, MOIST, GRAVEL TO 2". 1/8 INCH COBBLE-
5-0	SW/SM	3	••	₩	96	เา	35	SAMP/SILTY SAMP: LIGHT BROWN, MOIST, GRAVEL TO I INCH-
٠.٠		1		P	39	28		STETY SAME- LIGHT BROWN, MOIST, SOME GRAVEL TO I INCH-
	2H	1_		μp	130	31_		SAME: GREY, FINE GRAINED SAND-
	24	?		40	98	13		SAME: LIGHT BROWN, MOIST-
o-a		9		*	99	75	21)	SAME: SHOWN-RUST. FINE TO MEDIUM GRAINED SAND-
1.5	- 20	23	47	11	130	44		CLAYEY SAND: GREY, MOIST:
2.5	Ç#	4		Ψ	97	25		STLTY SMIT: TROWN, MOIST-
4 :4				*	34	5	19	SAND/STLTY SANTE: SREY, MOIST, FINE TO MEDIUM GRAINED-
á-2	SD /5#			ų	97	5		SAME: COARSER GRAIN, SOME GRAVEL, RUST STAIN TO 2 INCHES
	39	ù			39	4	19	SAMD. GREY, MOLST, COAPSE SHALMED SAND, SIME GRAVEL.
	597591	•		۴	99	5	13	SAMO/SILTY SAMO: GREY-BROWN, MEY, MEDITH GRAINED SAMO-
		?6		13	57	37		CLAYEY GRAVELLY SAMD: "FREY WET, COMESTIVE-
				ı,	7i	1	8	SAMP/CLAYEY SAMD: GREY, NON-CONESIVE, GRAVEL TO 3 INCHES
25:5		*					4	
• •	4		45			55		SAMPLY STILT: PARK GROV, CONESTVE, NO GRAVEL.
9.0	3 75				क	<u> </u>	16	CHENTALLY CHEN: GREY-MECHAN, FINE GRAINED SAME, NON-COMESSIVE.
	1	28	45	25	100	57		SAPPY (LAY- SREY, CHESTIVE-

<u> TH83-1903</u>

TH83-13	04			4354	or i	11-	183	-1904 FL. 93±
HIP	LDG	40		5-		-200	N	JESCHIPTI I
		ξ.		_Y		8		SAND/STUTY SAND: LIGHT GREY, TO GRAVEL TO 1-1/2 INCHES, COBALES
	SW/SM	1		¥ .	1			SAFE: LIGHT BROWN, GRAVEL TO 3
4.5				*	3*	11	30	SATE: CIGHT BROWN, GRWEL 10 7
<u>6.0</u>	y *	;		*	14	17		SILTY SAND: TARK BROWN, 4015T. GRAINED SAND, GRAVEL TO 3/4 INC
		9	13		13	42	27	SAND/TELTY SAND, RADING HOLST, SAND-
	5#		47			47		SAME: SOME ORGANIC MATERIAL.
J.5							10	
2.0	Ø./₹#			Α.	3.			SAMDING TY SAMPE LIGHT SHOWN ORGANIC MATERIAL, GRAVEL 374 IN
3.5	SP	ξ			- h	?	16	SAMD: BROWN-GREY-RUST, MOIST.
	9P/QN	5		٠	13.	,		SAND/STLTY SAND: LIGHT BROWN. TO 2 THORES!
	50	24	;,	.1	;v	2)	13	CLAYEY SAND: BROWN MOIST, SOM
18:0	cı.	28	ţŧ			69	ζ	SAMDY SILT: DAMY BROWN, HOIST,
20.0		25	14	14		59		SAMPY CLAY, DARK BROWN, POST
_::_a	Œ	3.7	44	•	.~	10		CLAY: NET-
25.0								
	ą.	\$e		ų	(39	74		SAMDY SILT: MARK BROWN, WET, I
29.0 29.0	<u>a</u>	-31	125	, in	ŢŒ-	78		CANDY (LAY: DARK BROWN, MEY, C

	9	FA 519	•00 C		F., 87±							
	LL	P:	-4	-200	4	DESCRIPTION						
			59	7		GRAVELLY SAND: GREY, MOISY, ORGANIC ODOR, VEGETATION OCCASIONAL BOULDERS TO 74-INCH-						
	44	2"	:00	**		SAMEY (LAY, BROWN, MET, COMESIVE-						
	31	Ħ	100	5.*								
į.	31	12	100	 58		[44] - Arom, Wet, Comesive, Groundmater encountered-						

185+00 I		r gte
. 4 -2		Echieli M
<u> </u>	1	PART (1 LAY) 1547 (JREY L MOIST, MEDIUM GRAIMED SAND.
3	<u>†</u> : ,	TARE 1991 SHOWN, SRAVEL TO \$ THOSESS
· # :	-	SPAINED LAND, 29AVE. TO 3/4 INCHES.
199 .	2 7*	SAN TO THE REPORT OF THE TO TEDLOM SHAINED
ln .	-	TATE OF STREET MATERIAL.
	4	MANUS THE SERVER STATE SHALL SHALL THE SHALL SHA
- ···· <u>-</u>		MIT PROMESPECERIST, MOIST, MEDIUM TO COMPSE GRAINED
1.10	,	CANDIST TO CANT 15HT BROWN, MOIST, MON-COMESIVE, GRAVEL
170 2		1 sect (58) Section MOIST, some conteston, conducts 1-4".
176 60		CANNY 10 " TANK BROWN HOIST, TOWESTAR.
190 sq		SANDA L'EN SAMA BASANT MILLE COMEZINE
100 10	-	OM et.
		CARTY CHILL THANK BRIDGE WET, CONFISIVE
তো স		MIN TAN MON, NET, COVESTIVE.

TH83-1	902		s	TA SQE	1-80 L		11	TH 83~1902				
DEPTH	L06	MC	u	PI	4	-200	- N	DESCRIPTION				
	SW/SM	1		WP.	91	12	5	SAMP/STLTY SAMP: LIGHT BROWN, MOIST, MON-CONESIVE, SOME CORRUES 4 INCHES				
3.0		2		ΨÞ	96	7		SAFE: MEDIUM GRAINED SAND, GRAVEL TO 1 INCH-				
4.0	1	77		Mb.	100	53		SARDY SILT: MARK BROWN, MOIST, SOME COMESTIVE.				
		9		NP	96	37	7	SILTY SAND: BROWN, MOIST, FINE GRAINED SAND.				
	Se.						8					
		4		**	99	14		SAME: CIGHT BROWN-GREY, HOW-COHESIVE.				
2.0												
	SPICH			¥	99	,		SAND/SILTY SAND: LIGHT BROWN GREY, MON-CONESIVE-				
.0		75	34	10			10					
	N2/W2	15	24		38	<u>51</u>		SAMP SILT: DARK BROWN, MOIST, COMESTVE				
-0	5	-2:	74	19	-	39		SAMD/SILTY SAND: BROWN, WET, SOME COMESION. CLAYEY SAMD: DANK GREY-BROWN, WET, COMESIVE.				
·0							11	CLRET THRU: UNK GREY BROWN, MET, CONESIVE-				
17.5	SN	18		₩.	100	32		SILTY SAMD: DARK BROWN, HET, COMESTVE.				
-5												
		29		*	133	76		SANDY SILT: BROWN, WET, COMESTVE, PLASTIC-				
	٦	30		No.	100	76						
-D							3					
-	î.	30	35	13	100	15	,	SAMBY CLAY: BROWN-RUST, WET. COMESIVE, PLASTIC-				
.0	*						3					
		28		ΥP	100	76		SAMBY SILT: BROWN-RUST, WET, COMESIVE, PLASTIC-				
	*	34			190	76						
.0			-1		*	,0						

	INVE	RT				T.	T 79	-21
1179-21			5	74 4974	50 C			£L · 87±
DEPT#	-06	ж	U.	ÞJ	-4	-200	н	DESCRIPTION
1.0	20	1						GRAVELLY SAID: BREY, VESETATION, GRAVES TO 2" - SROUNC-

I SEE PLATE 19 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
2 SEE PLATE 84 FOR LEGEND AND CLASSIFICATION SYSTEM 3 SEE TABLE 8 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED

4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS STHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.



SYMBOL	SECURIO S	DATE	1						
*******	REVISIONS								
	l c	PENGINEER DISTR OS ANGELES OF ENGINEERS	cī						
DESIGNED ST.	SARTA ANA P /ER MAINSTEI PHASE II GENERAL DESIGN M								
BRAWN ST.	LOGS OF INVESTIGATIONS								
	CORPS OF ENGINE	ERS							
CHICAGO PA	STA.518+00 TO STA.	485+00							

TT79-20

TT84-1982

£.		00 C	A 477+	51	ERT	T 18 4~19	
THESCH	-200	-4	ÞI	ů.	MC	L06	DEPTH
SILTY SAND: LIGHT GREY, M	 79	100	•			94	
							3.0
SAMPY STLT: PARK BROWN, H	80	100	11	4 3		٩	
							5.0
FLAY: THANK BROWN, MOIST,	89	99	13	43		α	
							7.0
CLAY: BARK BROWN-GREY, ME COHESTIVE	97	100	22	5.5		ÇH	
							10.0

TT84-1982

2.	TA 477	4 00 1		Q. 77±						
	»:	-a	-2 Y:	N PESCRIPTION						
	*	117	т,	SILTY SAMP. LIGHT GREY, MOIST, FINE GRAINED SAND, CORESIVE.						
u)	11	;7		SANTY CILT: TARK BROWN, MOIST, CONESIVE-						
45	<u>'</u> 9	14	₹1	CLAY- PAGE BROWN, MOIST, COHESTIVE, ORGANIC MATERIAL-						
7.		.``	3.	CLAY: DARK BROWN GREY, MOIST, SOME GRAVEL TO 1/2 THOMES, CONESTIVE:						

TH84 - 1905

THB4-1	905		S	TA 474	+00 R			FL- 90±
DEPTH	L06	MC	LL	PI	-4	-200	н	DESCRIPTION
	SP/SM	4		HP	96	6		SAND/SILTY SAND: BROWN, MOIST, LOOSE, FINE GRAINED SAND, SOME GRAVEL.
3.0	SM	6	_	u p	98	21	30	SILTY SAND: ROOM, MOIST, FINE GRAINED SAND, SOME GRAMEL
6.0	_				<u>_</u>		17	SAND/SILTY SAND: LIGHT BROWN, MOIST, FINE GRAINED SAND, SONE GRAVEL.
	9P/SK	5		*	99	5	11	
12:0	۹.	30	44	15	100	÷5	17	SANDY SILT. PARK BROWN, MOIST-MET. COMESIVE, STIFF, FINE GRAIMED SAND.
5.0							8	SILTY SAND: TROWN, MOIST-WET, CONESIVE, FINE GRAINED SAND
	571			φ	99	26	17	
1.0								
		34	t)	5	99	73	11	SMMTY SILT: MARK SREEN, MOIST-WEY, COMESIVE, STIFF, FINE SMAINED SAND.
	۹.	 54	£)	,	99	71	14	SAME: BARK SPOWN.
			54	9	39	73	7	
1:1								

SCALE. I HN+3FT

NOTES.

- I SEE PLATE 19 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2. SEE PLATE SA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

			1	$\downarrow =$				
SYMBOL	DESCRIPTION	4	DATE	APPROVAL				
	REV	ISIONS						
		U. S. ARMY ENGIN LOS ANG CORPS OF EN	ELES	a				
DESIGNED BY.	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM							
DRAWN SY,	LOGS OF INVESTIGATIONS CORPS OF ENGINEERS							
CHECKED BY.	STA.477	+00 TO STA.474+0	00					
SUBMITTED BY:	DATE	T		34657				

TH83-1906

TH83-1	906		S	TA 479	+00 L			
EPTH	LOG	ж	u	Pl	-4	-200	N	DESCRIPTION
1.0	SPI	3		*	92	14		SILTY SAND: LIGHT BROWN, MOIST, FINE TO MEDIUM GRAIN SAND GRAVEL TO 1-1/2 INCHES:
	59/59	6		NP	98	12	24	SAID/SILTY SAND: LIGHT BROWN, MOIST, FINE TO MEDIUM GRAINED SAND, GRAVEL TO 3/8 INCHES-
2.5		6	_	MP.	99	13		SILTY SAND: LIGHT BRN, MOIST, FINE TO MED- GRAINED :
	Ħ2	6		WP	100	14	25	
6-0.	-	п	23	1	100	40		SAME: DARK BROWN, MOIST, FINE GRAINED SAND-
7.5	M.	16	29	1	100	61	7	SANDY ŞILT: DARK BROWN, MOIST, FINE GRAINED SAND, (FIN SPT).
3.0	SM	5		МP	100	15		SILTY SAND: BROWN-GREY, MOIST, FINE TO MED., EVALUED
0.5	39	2			98	4	16	SAND: GREY-LIGHT BROWN, DAMP, MEDIUM GRAINED SAND OF TO 3/4 INCHES:
2.0	20/21	2		МP	99	6		SAND/SILTY SAND: GREY-LIGHT BROWN, DAMP, MEDIUM GRAI SAND, GRAYEL TO 3/9 INCHES
3.5	99	3			99	4	21	SAND: FREY-LIGHT BROWN, DAMP, MEDIUM GRAINED SAND, 6
5.0	6P	3		MP.	41	3		SANTY FRAVEL: GREY-LIGHT BROWN, DAMP, MEDIUM GRAIMED GRAVEL TO 3/9 INCHES-
6-5	5º/5#	6		₩	100	9	21	SAND/SILTY SAND: GREY-DARK BROWN, MOIST, MEDIUM GRAI
3.0	SM	8		ИP	100	15		SILTY SAND: LIGHT BRN, MOIST, FINE TO MEDIUM GRAINED
9.5	32	4			100	4		SAND: GREY, DAMP, MEDIUM GRAINED SAND-
	SIVSC	72	28	5	100	42		STLTY SAND/CLAYEY SAND: PUST-BROWN, WET COMESIVE, ME GRAINED SAND.
2-5_	3.436	23	27	5	100	27	,	SAME: "PARK GREY-
.0	1./0.	30	28	6	190	66		SANDY SILT/SANDY CLAY: GREY-BROWN, MET. COMESIVE, CO
5-5	4	28		NP	100	79	6	SAMILY SILT: DARK BROWN-GREY, MET, COHESIVE
2:2 7:3	α	31	45	24	100	77	·	SANNY (LAY: TRANK BRITHH-GREY, NET, COHESIVE
29.5	۹.	39		₩	190	70	7	SANNY STLT: MARK BROWN-GREY, MET, COHESTME.
2	2.	5 C	38	16	130	RO		SANTY (LAY: TARK BROWN-GREY, HET COHESIVE.
.5	••	29	₹1	14	199	90	Q	

TH83-1908

M84-13	v)\$		4	74 46/3	•00°			FL - 87±
¥E14		۳(Q.	Pį	-4	-270	h	PESCRIPTION
				Ψ	31			SAMP/SILTY SAMP. MROWN, MOIST, FIME TO MEDIUM GRAINED SAMP, COBPLES TO 4 INCHES.
	70/SM	¥		¥	36	[43	SAME: i.i.gat brown, Medium to coarse grained sand, graves $1\ \mbox{Inomes}$
4 5.		6		Мb	19	7	18	SAPE: PROWN-GREY, MOIST, MEDIUM TO FINE GRAINED SAND.
- / -	4	24	30	5	130	54	10	SAMEY SILT: PROMY, MOIST, FINE GRAINED SAMO
		16		ЯÞ	100	18	8	SILTY SAND- BRH-GREY, HOIST, FINE TO MEDIUM GRAINED SAN
	5 P	3		ΝĐ	100	18	,	SWE, LIGHT BROWN-
		9		40	គ្រា	18	14	
		i		μO	190	11		SAMIN/SILTY SAMIN- EIGHT BROWN-LIGHT GREY, MOIST, MEDIUM GRAINED SAMIN-
	5P/5M	5		40	19r	5	12	SAME - MEDICAL TO COMPSE GRATHED SAME
Ł		4		40	100	5		
1_	Ģ	4			83	•	10	GRAVELLY SAMD: LIGHT BROWN, MOIST, COARSE GRAINED SAND, BRAVEL TO 1 INCH.
	591	23		Ψ	130	18		SILTY SAND- THANK BROWN, HET, SLIGHTLY CONESIVE-
. i t							9	
ــــــــــــــــــــــــــــــــــــــ	ď	14	44	20	110	90		SAMOY (LAY: Elgar shown-oney, wer, conesive.
		13	39	12	190	90	5	SMMY SILT: LIGHT BROWN-GREY, NET, CONESIVE-
		31	25	ı	100	53		SAME: RMEY, MET, MLIGHTLY COMESIVE-
	٩.	28					5	SAF: TARY BROWN, NET, CONESIVE-
	1	33						
		!_	35	10	100	82	5	
		38						
1.5		29					,	

TH83-1907

TH83-19	.07		51	1 458	1400 L			₹L. 89 2
DEPTH	1.06	МС	LL	PĮ	4	-200	H	DESCRIPTION
	54	3		*	188	13		SILTY SMP: LIGHT BROME, MOIST, F SAND, GRAVEL TO 2-1/2 INCHES-
3.0	-	9-		F	100	17		SAME: COMBLES TO 6 INCHES-
4.5	æ	2		_	100	4		SAND: BROWN-LIGHT GREY, HDIST, HE
		10		₩.	99	• 1		SILTY SAND: DARK BRN-GREY-RUST,
	SM	11		*	100	38		SAME: SAMD LENS, ORGANIC MATERIA
3.0		16		No	92	49		
2.0		13		Ψ	100	17		THE MEDITY SANT: TARK BROWN-GREY
	SP/SM	2		МP	100	5		SAME: GREY, MOIST, MEDIUM GRAINE
	,,,	4		40	100	7		SAME: SOME ORGANIC MATERIAL, SAM
15.0		2		Мb	92	5		SAME: FOR GRAVEL TO 3/8 INCHES
44.54	9	2			92	3		SAND: GREY, MOIST, MEDIUM GRAINS 3/4 INCHES
18-0	,	2			100	4		3/4 Inches-
10	24/54	4		*	94			SANT/STLTY SAND: SREY, HOTSY, ME
21-0	39731	5		MP.	35	8		SAME: DARK GREY, COARSE SRAINED
22-5	7,0				93	4		SAMT: THE GREY, MOIST, COARSE SE
ж. 24./1	72/174			¥	38	:2		SAND/SILTY SAND: DARK GREY, HET GRAVEL TO 3/8 INCHES:
	20	18			96	3		SANT): THANK SREV, WET, CHARSE SR
<u> 25.5</u>		ę.	33	12	100	73		SAMRY ILLEY: BROWN, WET, COMESTIV
	-	2-	37	12	100	51		
28.5		ţ _o	51	29	100	71		SANDY CLAY: BROWN, WET, COMESTY
		ž.	52	25	100	88		CLAY: GREY-BROWN, WET COMESIVE

TH83-1907

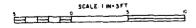
SF# 458+00 1					EL. 89±
٠,١	PI	-4	-200	3	DESCRIPTION
		100	13		SILTY SMP: LIGHT BROWN, MOIST, FINE TO MEDIUM GRAINED SAND, GRAVEL TO 2-1/2 INCHES-
_	_	100	14		SAME: COMMLES TO 6 ENCHES-
	. 40	toc			
		100	4		SAND: PROMN-LIGHT GREY, MOIST, MEDIUM GRAINED SAND-
	*	39	٥,		SILTY SAND: DARK BRN-GREY-RUST, MOIST, FINE GRAINED SAND.
	₩	193	ţ3		SAME: SAMO LENS, ORGANIC MATERIAL-
	Mb.	972	44		
	40	יין	!2		SMIT/SILTY SAME: TANK RROWN-GREY-RUST, SAME LENS, FINE TO MEDI: 99 SRAIMED SAME.
	NC.	18	5		SME: RREY, MOIST, MEDIUM GRAINED SAND-
	40	191			SAME: SOME ORGANIC MATERIAL, SAMO LENS 1/2 INCHES-
į	40	£.			SAME: FEN GRAVEL TO 3/3 INCHES-
· _		9.			SAND: GREY, MOIST, MEDIUM GRAINED SAND, FEW GRAVEL TO 3/4 INCHES:
		1.75	4		
	¥				SANT/STUTY SAND: SREV, MOIST, MED- TO COARSE GRAINED SAND-
	晔		3		SAME - DARK GREY, COARSE SRAINED SAMD, GRAVEL TO \$78".
)ı			SANT_1 THIC GREY, HOIST, COARSE GRAINED SAND GRAVEL TO 3.8%
	Æ.	10			SAMP/SILTY SAMP: DANK GREY, HET, COARSE GRAINED SAMD, JRAHEL TO 378 INCHES:
		7+	;		SAND, TARK GREY, WET, COARSE GRAINED SAND-
11		.,	*1		CAMEY CLAY BROWN, WET, COMESTVE-
۳	12	. Y	4.		
:	n	_			SANDY CLAY- BROWN, HET, COHESTVE-
	.35		.3		QAY TREV-BROWN, MET COMESIVE.

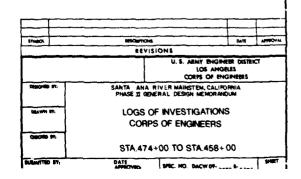
TT 79-19

INVERT	
9-19 STA 458+00 C	
TM LOG MC LL PI -4 -200 M DESCRIPTION	
97 6 98 7 SMIT: GREV, MOIST, VEGETATION, OCCASION O GROUNDMATER ENCOUNTERED.	AL GRAVEL TO 3/4",

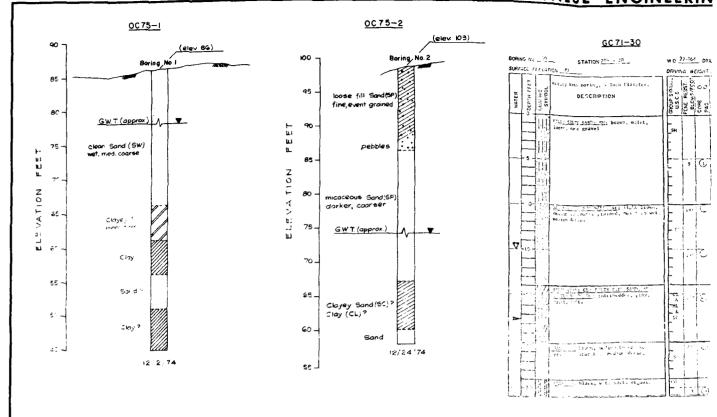
NOTES

- 1 SEE PLATE 19 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGENO AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE ORILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTEO AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE





MATER OLETTA FEET



			GC 71-33	
	NO TEL		STATION LELE L	WO 27-144 DESENTE 1-17-17 DRIVING WORTH 1546 16 16 17 18 16.
WATER	DEET'H FEET	GRAPHE "Y MAGE	e turi ni i besiriji e indi dsamitus nidi iseki i nigal DEmograpitusti	PENS REST 0.5 CS 0.5 CS 0.0 NS FEGT 0.0
			EDIC TELLER, which to may, figure to mis E, website Jenke.	SP
-	- 5		State Services	204 10-
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7	. 1		STATE M_ gre . "Africates	58
	-25			
	-34	111	itioner wight once with	

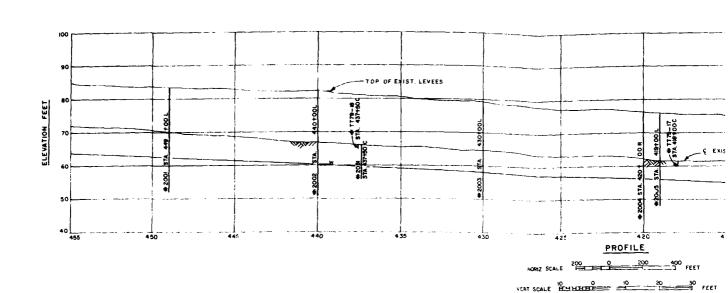
IOHNO NO IURFACE EL	CONTRACTOR LOS	\$1.000 10 1.20	w.	o Tillig Literatur	D 3.11 W 21	म्ह १ <u>८५८</u> स्टब्स्
WATER OLESTH CELT	STWICE STWICE	DESCRIPTION				7 310FT C 317+187% FF 52.04
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-		g, mada				
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▽ -20-		tation is to t			:	
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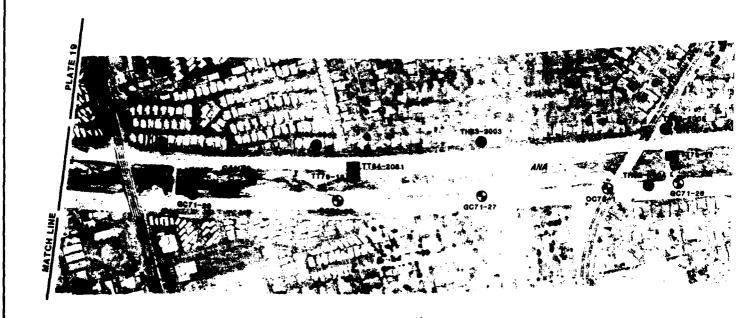
GC 71-34

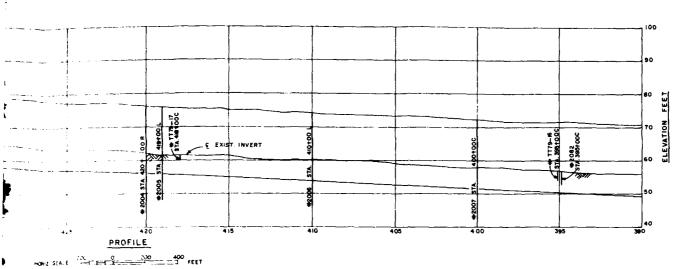
VALUE ENGINEERING PAYS GC 71-31 GC 71-32 GC 71-30 BORING No 11 WO 22-164 DRILL DATE 3/11/21 STATION 218 + 61 W.O. 22-164 DRILL DATE 3/12/71 LEVATION TO STATION W.O. 22-164 DRILL DATE 3/12/71 BORING No. 32 STATION 233 + 65 Draving WEIGHT 500 15 .. 20 in. DRIVING WEIGHT 500 15., 18 fr. WATER OCEPTH FEET SYNBOL SURFACE ELEVATION ... 92 DRIVING WEIGHT 500 15., 18 :-. GROUP S. ALEU. U.S. C. E. RESST BELOW FOOT CORE O CORE ORN CORSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE CONSTURE FOR STANDOL STANDOL LOS C.S. PENE, FESST. PENE, FESST. PENE, FESST. PENE, FESST. PENE, PENE OROUP SWAROL SE C.S. FERE RESSIT. BLOWSFOOT CORE D BAG D GAT CETSITY FC! MOSTURE CONTEYT'S. HELATIVE WATER ODEPTH FEET GRAPHIC SYMSOL Rotary wash boring; 4 inch diam ter Return Kinds and a little factor Rotery wash buring: 4 Inch diameter GRAZ HIC SYRBOL DESCRIPTION DESCRIPTION FILL SHITY SAND: SM; tan, moist, acclum dense. hos we crase! LETE FILL: SELTY CASS: SM; brown, maist, medium Gense. SM SAND: SP; white to gray, medium grained moi.t, redium dense; some grave! SAND: SP; tan to gray, medium grained, moist, exclum dense; some gravel. - 5 -SP 15 0 104.0 5.9 93 62.5 15.6 73 11 0 NATUTAL CREATE SHATE SANGE SATE tan L. gray, unist, medium deuse. 1.5 15 ② 96.2 20. 6 10 100 0 V 12.0 1.0 (LAND) SILTY SAID: 5"; brown const.; saddien dense; saturated into Saturated of 17.01 V. L au l - 20 - --20story and the projection of the control of the cont SM in -25-11 Οţ W 3 401 ريزا $\dashv w$ Timb 11: <u>WM73-5</u> LOG OF BORING 5 DATE OF BORING 22 Nov 1973 WATER DEPTH 14" DATE MEASURED 24" or 1973 TYPE OF DRILL PIG COST. FLIGHT AUGST MOLE DIAMETER 5" WEIGHT OF HAMMER 140 151. FALLING 33" SAMPLES 2" Meditied Celifornie GC 71-35 STATION A Grand world to the same BORNS No. BAUPLES BAUPLES BAUPLES BAUPLES UNIC COMP STREMSTH, MA MOISTURE CONTENT, MA DATA DE MSITY POT PER TESTS SUPPLY CO. DESCRIPTION PRECE ELEVATION Dense, damp, light brown fine to medium-grained SAMO (SP) with trace of SILT 102 * A* 5 5 5 4 5 34 5 $\frac{1}{2}|\hat{w}$ 88 | | | | | | | tiedius dense, very fine-grained SAM Hedium dense, unist hight brown fine-grained 1--1<u>0</u> 4 **X**11 Fine to coarse-grained 86 * O II-50 Botton of boring at 25k ft. 1,0-SYMBOL REVISIONS U. S. ARMY ENGINEER DISTRICT (OS ANGELES CORPS OF ENGINEERS SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM LOGS OF INVESTIGATION NOTES BY OTHERS I. SEE PLATE 19 FOR TEST SITE LOCATIONS. 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS. STA.520+00 TO STA.455+00

3. LOGS BY OTHERS ARE ONLY TO BE USED TO

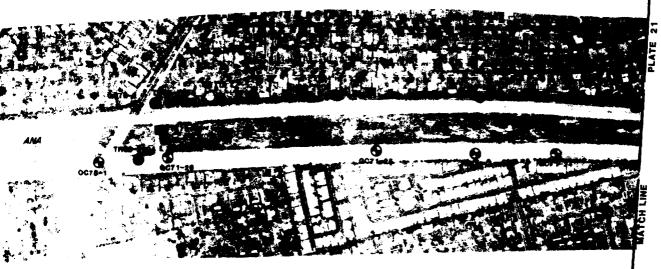
SPEC. NO. DACWOF-____B-___







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NOTES:

- I SEE PLATE 8 FOR LEGEND AND GENERAL NOTES.
- 2. SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

	_							
DATUM 15	NATIONAL GEODETIC	VERTICAL DATUM OF	1929					
SYMBOL	(MCMPNOH)		PARE	APPROV				
	REVISIO	340						
		U.S. ABMY BYGHE LOS ANGE CORPS OF BYG	LES	7				
SEEGOS PA		VER MAINSTEM, CALIFO PAL DESIGN MEMORAND						
Sharest Sh	PLAN	AND PROFILE						
STA.455+00 TO STA.390+00								
BURNITED BY:	DATE APPROVED.	MAC NO DVCM.		94				
	ĺ	DIÉTRICT PRE NO.		Ì				

TH 83-2001

TH83-2001			S	TA 449	+00 L			EL . 932				
DEPTH	1.06	#C	LL	PI	-4	-200	N	DESCRIPTION				
1.0	21/21	3		P	94	100		SAMI/SILTY SAMD: ROOM, MOIST, MEDIUM TO FINE GRAINED SAND, GRAVEL TO 3/4 INC/ES:				
		6		MР	98	15	34	STUTY SAND: PROMI, MOIST, FINE TO MEDIUM GRAINED SAND, GRAVEL TO \$74 INCHES.				
	Jan	7		MP	97	20		Branel III A. MCME2.				
3.5 4.5	5 0750	5		10	96	- 6	39	SMIT/SILTY SMIT: BROWN, MOIST, COARSE GRAINED SAND, GRAVEL TO 1-1/2 INCHES:				
6.0	SM/SM	3		MP	92	6		SMID/SILTY SMID: BROWN, MDIST, COARSE GRAINED SAND, GRAVEL TO 3/8 INCHES:				
7.5	39	4			95	4	35	SAND: BROWN, MOIST, COARSE GRAINED SAND-				
9.0	51/51	4		MP.	97	10		SAMD/SILTY SAMD: BROWN, MOIST, COARSE GRAINED SAMD, GRAVEL TO 3/8 INCHES				
	SP/SM	4		NPP	96	7	8	SAMD/SILTY SAMD: LIGHT BROWN, MOIST, COARSE GRAINED SAMD GRAVEL TO 1 THCH.				
12.0		6		жP	99	10	-					
		3			96	4		SAMT: LIGHT BROWN, MOIST, COARSE GRAINED SAMD, GRAVEL TO				
		2			99	4		- Inch				
	20	?			76	,	11					
		9			99	4	••	SAME: MET, GRAMEL TO 1-1/2 INCHES				
19.5					95	4	8	SAME: BROWN, GRAVEL TO 3/3 INCHES-				
	SM	5	22	ı	99	25	-	STLTY SAND: BROWN, WET, COARSE GRAINED SAND-				
22.5		22	28	5	100	43	6					
24.0	AL/C	26	79	,	98	62	٠	SANDY SILT/ SANTY CLAY: DARK GREY, HET, COHESIVE.				
		27	29	٩	10C	57	6	SANDY CLAY: DANK GREY, MET, COMESIVE.				
	(L	28	₹6	15	100	80	·					
		ţr.	TO,	17	99	78	9					
10-a		য়া	14	15	100	73	7	SAME - PARK BROWN				

TH 83-2003

TH83-21	TH83-2003		\$1	A 430	•00 L		FI 79±				
DEPT4	LNG	ac	LL	P1	-4	-200	N	DESCRIPTION			
1:0	24	5		P	100	15		STUTY SAND: LIGHT BROWN, MOIST, FINE TO MEDIUM GRAINED SAND.			
- V.	52/54	-5		1	97	8	11				
3.0		τ-		Ŧ	95			SAND/SILTY SAND: LIGHT BROWN, MOIST, FINE TO MEDICAL GRAINED SAND, GRAWEL TO 3/4 INCHES:			
1.5	3 0	3			95	2	10	SAND: LIGHT BROWN, MOIST, MEDIUM TO COARSE GRAINED SAND. GRAVEL TO 1. LINCH.			
		4		₩	95	6		SANT/SILTY SANT: LIGHT BROWN, MOIST, MEDIUM GRAINED SAND,			
	SPISM	<u> </u>		ф-	77			GRAVEL TO 3 INCHES			
4.9	7	3.		\$	100	25		SILTY SMID: LIGHT BROWN, MOIST, FINE GRAINED SAND.			
2.0	54/50	9	25	6	100	47		SILTY SAMPICLAYEY SAMD: JIGHT BROWN, MOIST, FINE GRAINED SAMD:			
10:5	SM.	2		40	(0)	26	15	SILTY SAND: LIGHT BROWN, MOIST, FINE GRAINED SAND-			
		ı		*	98	7		SAND/SELTY SAND: LIGHT BROWN, MOIST, FINE GRAIMED SAND-			
		1		Ψ	1/10	*		SEE- RREY, MOIST-			
	SP/SM	3		Ψ	98	,		SME: DANK GREY.			
		5		₩	98	5		SAME: GREY, FINE TO MEDIUM GRAINED SAND-			
18.0		3		100	100	8					
		3		₩	199	14		SILTY SMITH: GREY, MOIST, FINE TO MEDIUM GRAINED SAND-			
	99	12		Ψ	100	15		SAME: "NAMY GREY"			
		16			130	16	10				
<u> 21.a</u>		<u> </u>		4	100	- 15		SAFE DARK BROWN, NET-			
24.0	CH.	35	53	28	100	95		D. AY- MARY GREY, MET, COMESTIVE, PLASTIC, SOFT-			
	SM.	78		P	100	49	5	STUTY SARTS: "MARY GREY, HET, SOFT-			
		25		₩.	100	33		SAPE: FINE GRAINED SAND			
27.0		3		-	150	- 52		SAMPY SILT: DAME GREY, MET, FINE GRAINED SAMD.			
28. 5	4	35-	v	17	100	71	12	SAFE: COMESTOR.			
4.0	9	1			100		-	SILTY SAND: MAN DANK MARY, MET, FIRE TO MED. GRAINED SHO.			

TH 83-2002

TH83-2002 DEPTH LOG		57	A 440	100 L			EL. 82±
L06	MC	LL	PI	4	-200	×	RESCRIPTION
	10		ΝP	100	35		SILTY SAND: BROWN, MOIST, NON-COMESIVE
	_					16	
	11						
	16		*	100	37	4	
SM	12					•	
	20		W	100	49	7	
	11		ъp	100	23		SAPE: I, IGHT BROWN-
	12					2	
a	4	39	3	100	59		SANDY CLAY: BROWN, MOIST, FINE TO MED
29	2			190	2	10	SAND: I, IGHT BROWN, MEDIUM TO COAPSE 3
	4		40	100	8	14	SAND/SILTY SANT: LIGHT BROWN, MOIST,
2512U	6		ų¢.	97	10		GRAINED SAND- SANF): I_IGHT BROWN-GREY-
	17			100		14	SMIT: LIGHT BROWN SREY, WET, METLE
							SAND-
29	70					19	
	20						
	32		¥	:33	3		SANDAZILIY SANDE FIRMS ALTONOMESHAN
30/34	_						GRAINED SAND
	19-						
		79			69		SAMINY MAY: BROWN, HET COME LIVE
	26						
	28						SAME: TARK SROWN:
σ	_						
	33						
	30						
	1. 1. 9. 59/5H	SP/SN 4 6 20 20 59/SN 2 20 20 28 33 33 33 33 33 33 33 34 35 35 35 35 35 35 35 35 35 35 35 35 35	SP/SM 4 59 20 SP/SM 4 59 20 SP/SM 52 20 SP	SP 2 SP/SM 4 \$P 17 SP 20 SP/SM 4 \$P 17 SP 20 SP/SM 4 \$P 17 SP 20 SP/SM 4 \$P 17 SP 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 2 \$P 20 SP/SM 3 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 4 \$P 20 SP/SM 5 \$P	No	SP/SM 100 29 20 20 20 20 20 20 20 20 20 20 20 20 20	10

TT 87 - 81

INVERT [184-208]			51	n	· · · c			w/y
DEPTH	ĻŊĠ	MC		3.	-4	-200	N	Teknerat, #
	SW/SM			Æ.	35	12		SANTYSTICTY SAND TRANSPORT HE TO HE SHARED TO DESCRIPT
3.0								SARDY PLAY TABLER WAS HET THE C
	n.		44	23	યલ	91		
10.0								

VALUE ENGINEERING PAYS

TH 83-2002

	STA 440	>+00 L			EL- 82±
Ļ	PI	4	-200		DESCRIPTION
	10	100	35		SILTY SAND: BROWN, MOTST, HON-COHESTVE, FINE GRAINED SAND-
				16	
	V P	100	37	4	
	Ψ	100		,	
	ЖP	100	"	,	SAME: LIGHT BROWN-
79	3	100	 23	9	SANDY (LAY: BROWN, MOIST, FINE TO MEDIUM GRAINED SAND.
		inc	:	19	SANT: THE RROWN, METILIN TO COARSE GRAINED SAND-
•	*	130		.4	CANDICILITY SAND: LIGHT BROWN, MOIST, KIME TO MEDIUM GRAINED SAND
	45	à.	:	19	SAPE: LIGHT BROWN-GREY-
		10			SWIT: LIGHT BROWN-GREY, WET, MEDIUM TO COARSE GRAINED SAND.
				11	
	¥	¥*.			SMOUSTLY SMITH LIGHT BROWN-GREY, MEY, MEDIUM TO COMPSE GRAINED SMICH.
		.70x	23.		SHAN THE BOOM, MET, COMESIVE.
					SAME PARK SROWN

TH 83-2004

HB3-20	004		\$1	A 420	+00 R			£L - 75±
ЕРТН	L06	MC	LL	Pl	-4	-200		DESCRIPTION
1.0	SW/SM	4		NP	98	12	38	SAND/SILTY SAND: BROWN, MOIST, FINE TO MEDIUM GRAINED SAND:
		4		NP	94	13		SILTY SAND: PROMI, MOIST, MEDIUM GRAINED SAND-
		7		TIP.	98	13		
	SM	5	21	ı	81	15	40	SILTY GRAVELLY SAND: GRAVEL TO 1 INCH-
5-0		6		NP	94	14		SILTY SAND: DARK BROWN-
7.5	SP/SH	7		₩	97	6	41	SAND/SILTY SAND: BROWN-GREY, MOIST, MEDIUM TO COARSE GRAINED SAND, GRAVEL TO 3/8 INCHES.
		3			94	3		SAND: GREY, HOIST, COARSE GRAINED SAND, GRAVEL TO 3/8
	39	4			. 94	7		
0.0		10	21	-1	99			
2.0	SM	16	??	?	100	34		SILTY SAND: DARK BROWN, MOIST, FINE GRAINED SAND-
	SP	3			97	4	14	SMID: GREY, MILIST, MEDIUM TO COMPSE GRAINED SAND-
.0		4			97	3		
5.5	SH	20		MP	99	14	10	STLTY SAMD: BROWN-GREY, MOIST, NON-COHESIVE, FINE TO MEDIUM GRAINED SAMD, LAYERED SAMD-
3.0	sc	15	31	9	98	25	••	CLAYEY SAID: TARK GREY-BROWN, MOIST, FINE TO MEDIUM GRAINED SAID.
-	SP/SM	19		NP.	100	11	17	SAND/SILTY SAND: GREY, MET, MEDIUM GRAINED SAND-
L-0		17		₩P	190	9	-	
	ML/CL	27	25	á	190	41	6	SAMDY SILT/SAMDY (LAY: DARK GREY, WEY, COHESIVE-
		27	25	5	100	52		
	a	31	37	13	100	65		SAMBY STLT: THAN GREY, HET, COHESIVE-
-0		26	25		100	.65	13	
	M.	26	27	1	99	54		SANTY SILT: TARK GREY, WET, FINE TO MEDIUM GRAINED SI HON-COMPSIVE:
7.0								
3.5	54	23		Ψ	100	24	18	SILTY SAND: GREY, WET, FINE TO MEDITE GRAZIED SAND-
	α	37	40	17	39	24		SAMPY CLAY. MARK GREY, WET, COMESIVE-
		32	36	12	100	92		SAME: RLACK, WET, COMESTIVE.

TT 84-81

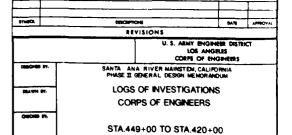
re unite50 r	5 ₁ . 66¢
et et je g	PESCRIPTION
A. fe	CAMP/SI/DY SAMD THAT SARDAN, NET, SEDIJA 10 COARSE SAND, JEANEL TO LINCH.
	ARTY 7.5Y Dani BROWN, WET, CONFSTVE

TT 79-18

14VER 1779-13			\$1	A 4374	53 C			ct. 552
DEPTH	L06	#C	Lt.	PI	-4	-200	N	PESCRIPTION
1:0	\$	6			97	1		SAMD: SHEY, MOIST, VEGETATION, GROUNDHATEN ENCOUNTEMED.

NOTES:

- I SEE PLATE 20 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



SCALE I IN SFT

VALUE ENGINEERIN

TH83-2005

THB3-2	005		s	TA 419	+00 L			EL · 76±
DEPTH	L06	MC	u	Pl	4	-200	14	DESCRIPTION
1.0	591	2		NP.	96	13	9	STLTY SAMD: BROWN, MOIST, FINE TO MEDIUM GRAINED SAND, GRAMEL TO 1-1/2 INCHES:
	SP	+			90	- 3		SAND: GREY, MOTST, MEDIUM GRAINED SAND, GRAVEL 3/4".
3.0		1		Ψ	96	5	8	SAND/SILTY SAND: GREY, MOIST, MEDIUM GRAINED SAND, GRAVET TO 3/4 INCHES
	2P/SM	1		MP.	39	9		SAME: Moist-
6.5 7.5	SA	3		1	100	19	12	SILTY SAMD: GREY, MOIST, MEDIUM GRAINED SAMD-
	SP/SM	2		NP	100	5		SAND/SILTY SAND: GREY, MOIST, MEDIUM GRAINED SAND-
9.5 10.5	SP	1			97	2	17	SAID: SREY, MOIST, MEDIUM TO COARSE GRAINED SAND, GRAVEL TO 3/8 INCHES.
12.0	SP/SM	3		MP	99	7		SAND/SILTY SAND: GREY, MOIST, MEDIUM GRAINED SAND-
13.5	SP	1			100	2	14	SAND: GREY, MOIST, MEDIUM GRAINED SAND-
15-0	SP/SM	22		ΝP	100	8		SAND/SILTY SAND: GREY, MOIST, MEDIUM GRAINED SAND-
16.5	٩	28	41	14	100 99		14	SILT: GREY, MOIST, MEDIUM GRAINED SAMD- SAMDY SILT: BROWN, MET, PLASTIC-
18-0	SP/5H	11		¥Ρ	100	9		SMED/SILTY SMED: BROWN-RED, WET, MEDIUM TO COARSE GRAINET
19.5	3 P	3			100	4	26	SAYD: GREY, WET, MEDIUM TO COMPSE GRAINED SAND-
21-0	9P/SM	19		Ψ	100	5		SAMB/SILTY SAME: SREY, HEY, MEDIUM IT COARSE GRAINED SAME
22.5	39	11			100	3	19	SAMI): SREY, MET, MEDIUM TO COAPSE SRAINED SAMD-
24.0	SP/SM	23		₩	100	3		SAND/SILTY SAND: GREY, NET, NEDIUM TO COARSE GRAINED SAND-
	a	18	34	15	100	65	3	SAMBY CLAY: DARK BROWN, WET, PLASTIC-
26.5		25	37	17	100	50		
8.0	S#	23		₩	100	15	29	SILTY SAND: DARK GREY, HET, FINE TO MEDIUM SRAINED SAND-

TH83-2006

1483-20	XX6		51	A 410	-00 L			FL. 74±
DEPTH	L36	NC.	LL.	P!	-4	-200	н	DESCRIPTION
	\$	1			93	4		SAND: LIGHT BROWN, MOIST-
1.0	<u>SM</u>	10		-	97	21	14	SICTY SAND: LIGHT BROWN, MOIST, MEDIUM GRAINED SAND
2:0 2:5	32	16	31	- 21	100	- 47		CAYEY SAND: LIGHT MACHY, HOLST, FINE-GRAINED SAND-
4.5	S#I	13 10		-	 36 -	- 15 33	20	SILTY SAMD: LIGHT BROWN, MOIST, FINE GRAINED SAMD- SAME: LIGHT BROWN, MOIST, MEDIUM GRAINED SAMD-
		T			131	74	20	SILT: LIGHT BROWN, MOIST, MEDIUM GRAINED-
1.0				¥	100	- 33		SILTY SAMD: LIGHT MADRIL MOIST, MEDIUM GRAINED SAMD.
	ca \ 24	4		MP.	29	9	1?	SAND/SILTY SAND: LIGHT BROWN, HOIST, MEDI/M GRAINED SAND
2.2		3		NP	39	12		
10.5	20	1			36	4	29	SARD: LIGHT BROWN, MOIST, MENIUM TO COARSE GRAINED SART, GRAME, TO 3/3 INCHES.
		2		*	99	,		SAMPLYSHITY SAME. LIGHT BROWN, MOIST, MEDIUM TO COAPSE GRAINED.
	39/54	7		φ	39	5	20	
15-0		21		*	95	5		
	ቅ	,			95	4	25	SAND: LIGHT BROWN, MOIST, MEDIUM TO COMPSE GRAINED SAND GRAVEL TO 1/2 INCHES.
12-0		13		W	99			A10 14 14 14 14 14 14 14 14 14 14 14 14 14
	52/SH	10		₩P	39	5	30	SAMD/SILTY SAMD. LIGHT BACHN, MOIST, MEDIUM TO COARSE GRAINED-
	7731	23		₩	99	6	39	
22.5		20		₩	99	9	15	SART - SAME TO 1/4 INDIES.
	Ç#	75		40	38	46	15	STILTY SAMD: GREY, MOIST, FINE TO MEDIUM GRAINED SAND-
24. 5		7				- 75		SATE, LIGHT RECON CORY,
25.5-	3/4	-79		-	100	- #	10	SID/S TY SHO! LIGHT BROWN GREY, MOIST, FIRE TO MED GRAINED SHO!
27.0	sc	77	28	19	100	41		CLAYEY SAILD: BROWNISH-BREY, HOIST, FINE GRAINED SAID.
7 5	. 32/3n	77	_21	*	100	- 5	28	S. BEHTLY COMESTVE. SILTY SHID: LIGHT SHOWN, MOIST, FIME GRAINED SHID. SHID/SILTY SHID: LIGHT SHOWN, MOIST, FIME GRAINED SHID.

<u>TH83-2007</u>

T HB3 -21	007		\$	A 400	+00 L			
DEPTH	L06	ĸ	ĽĹ	PI	-4	-200	N	
	SW/SM	3		- P	99	10		SAMP/STLTY SAMP: L
2-0				-	- 99	- 70	25	
	34	7		-	99	र्ग		CILTY CANN: RROWN.
9.5			- 75		170	- 56	15	CHANGE THE PROPER
5.5	- 0	17	- 13		100	- 72		CAPPY TILY: Sersey.
5.5 7.0		••			98	- 21		STLTY SAMD: GREY.
8.5	52/SH	10		- 	_ 	12	15	SAMINAZIFIA ZANJI:
9.2	Zié	?		MP.	99	13		STLTY SAND: GREY,
11.5	3.	15		40	99	23	14	
		3		40	99	9	17	SANDASTETY SAND SI
		,		40	99	7		
	5º/\$4			φ	39	5	17	
		3		*	100	9		
19.0		28		40	29	5	15	
20.5	75	•	-	•	98	18		STUTY SANTI- GREY.
		21		ψp	39	8	٦	SANDUSTLEY SANDE SE
	7P/9M	3		185	77	- 9		SAND-
24:0		is_		40	99	3		
	9	1 <u>5</u> 25			38 100		,	SAMP: SREY, MOIST.
25.5		75			100	- 3		SAME: FINE TO MEDI-
29.0	(E/S#	25		40	39	5	27	SAMEN/SILTY SAMEN: FR
79.5 10.8	97	14			100	4		SAND: GREY, MOIST,
					100	व्य		STT: "REV, MOIST,

TH84-2082

FL. S			2) (A 395+	7.7.		82	1134-20
DESCRI	4	-200	-4	2[ξ.	*(L06	DEPTH
SAND: MULTICOLOR, MOIST, M GRAMEL TO 1 INCH, VERY LOOS		1	37				3°	
STETY SAND: DARK BROWN, MC SAND, WITH FEN GRAVEL, DENS		25	का	- V			T	3:0 4:0

TIP9 16 CLASSIDIC C.		 L04	ж.	Į.	21		-200	4	
					1 1960	95 E			FL.
T T 79-16	INVERT							<u>TT79-16</u>	

VALUE ENGINEERING PAYS

TH83-2007

	51	A 400	-00 1			EL · 73±
MC	ш	PĮ	-4	-200	н	DESCRIPTION
3		*	99	10	25	SAND/SILTY SAND: LIGHT GREY, MOIST, MEDIUM GRAINED SAND
7		10 10		**	2"	SILTY SAND: PROMI, MOIST, FINE TO MEDIUM GRAINED SAND-
-	74	-	18	<u></u>	15	CANTY CILT: "ROMM, MOIST, FINE GRAINED SAND.
12	28	3	140	- 72		CARTY (LAY: MATHEN, MOIST, FIME GRAINED SAND.
7			30	. 1		CTLIN SAND, GREY, MEDIUM GRALPET SAND
0		NO.	3:	1.	. 5	SANDY/SILTY SAND: GREY, HOIST, HEDERM GRAINED SAND-
7		*	31	14		STUTY SAND. SREY, MOIST, MEDIUM GRAINED SAND-
5		•	* :	.3	14	
₹		*	39	3	!"	SANT/SILTY SANTE GREY, MOIST, MEDIUM GRAINER SAND-
,		**	36	•		
•		\$	h.	4	12	
		•	1"	3		
₹		40	Pì	¢	15	
;		•	¥2	12		CTUTY CAND - SREY, HOIST, HEDIUM GRAINED SAND.
		*	,4	4	1	SAND/SILTY SAYD. SHEW, HOIST, MEDIUM TO COARSE GRAINED SAND.
		-	77	3		
		10	- 50	5		
			<u> </u>			SAMP: SHEY, MOIST, COARSE GRAINED SAMP
			139	-	,	SAME - FINE TO MEDIUM GRAINED SAND-
ş				5	27	SANT/SILTY SANTE GREY, MOIST, MEDIEM GRAINED SAND
_		40	¥5.	•		
5		4 c	17°			STATE SREY, MOIST, MEDI M GRAINED SAND-

TH-2008

MB3-2	008		S1	A 390	+00 L			EL. 71#
DEPTH	LOG	MC	u	PI	-4	-200	N	DESCRIPTION
2.0	SM	,		цр	98	14	7	SILTY SAMD: BROWN, MOIST, FINE TO MEDIUM GRAINED SAND GRAVEL TO 3/8 INCHES
3.5	\$9/\$# \$9/\$#	1 ?		#₽°	98	6		SMD/STUTY SMD: LIGHT BROWN, MOIST, MEDIUM TO COARSE GRAINED SMOD, GRAVEL TO I INCH-
4.5_ 6.0	SM	4	50	20	96	13	37	SILTY SAND: PROMY, MOIST, FINE TO MEDIUM GRAINED SAND
7.5	SP/SM	3		ML,	10	3	9	SAND/SILTY SAND: ROOMY, MOIST, FINE GRAINED SAND-
3.5	54	4		W	130	- !7	,	STLTY SAND: BROWN, HOIST, FIME GRAINED SAND-
	SP/SH	2		¥	100	10_		SAND/SILTY SAND: BROWN, MOIST, FINE GRAINED SAND-
1.5		2		₩	98	6		SAME: LIGHT GREY, MEDIUM GRAINED SAND-
3.0	SP	1			98	3		SAND: LIGHT GREY, MOIST, MEDIUM GRAINED CAND-
4.5	SP/SM	5		蟾	94	6		SAND/SILTY SAND: LIGHT GREY, MOIST, MEDIUM TO COARSE GRAINED SAND.
		8		MP	100	15	18	SILTY SAMP: LIGHT GREY, MOIST, MEDIUM GRAINED SAND-
		24		МÞ	100	28		SAME: DARK GREY, MET-
	SM	18	51	22	100	45	6	
		26	41	12	100	31		
		22		颗	100	18	q	
3.5		27		-	100	45	ĺ	
		31	32	8	100	81	9	SAMOY SELT: DARK-LIGHT GREY, WET, COMESIVE-
		30	٠-	10	100	85		
		39		*	100	39	g	SAME: DARK GREY-
	٩	37		₩	100	84		
		32		190	100	ำเ	16	
		_		₩	100	100		
4.:2		29		- TOP	100	<u>54</u>		

TH84-2082

** 395	-00-1			Fi. 57±
PI	-4	230	•	DESCRIPTION
	37			SAID - NULTICOLOR, MOIST, MEDIUM TO COARSE SRAIMED SAND. JAAREL TO L INCH. VERY LODSE.
·····•	·· ? ;) इ.		STUTY SAND DANK BROWN, MOIST, FINE TO COMPSE GRAINED

TT79-17

TT79-17	,		\$1	ra 418+	0 0 C			ej. 67\$
DEPTH	L/16	W.	u,	PI	-4	-270	H	DESCRIPTION
1.0	3	Б			98	7		SAND: GREY, MOIST, VESETATION

TT79-16

99	5	1	SAME: GREY, MOIST, OCCASIONAL BRAVEL TO T/A-INCH, VEGETATION. GROUNDMATER ENCOUNTERED AT 7-5 FEET
a! 4	-7	n u	DESCRIPTION
14 195400	ί		Fi , 579

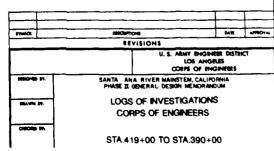
NOTES

I SEE PLATE 20 FOR LOCATION OF TEST HOLES AND TEST TRENCHES

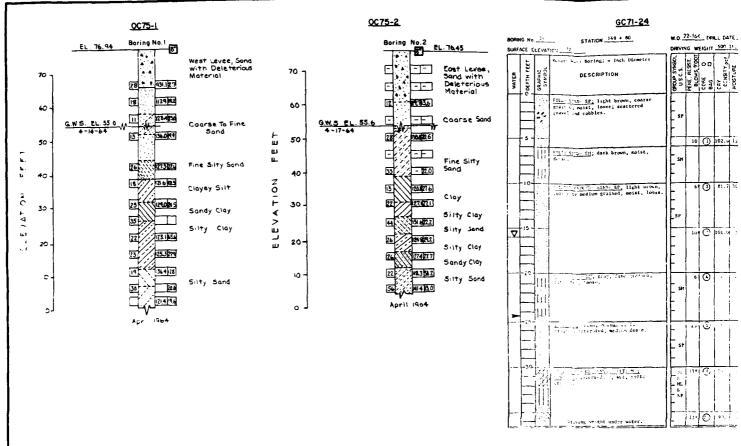
INVERT

- 2 SEE PLATE 64 FOR LEGENO AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVRE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE





VALUE ENGINEERING



GC71-27

Intercolled with CLAVIL OF.	- [BLOWS, FCOT CORE O BAG CI	, ye.		1
State Annual County State Stat		# 8 E	C-4Y OENSATY	MC.STUPE CONTENT	RELATIVE
MASS of the transfer to the brown and the br	SI				
To see the same of the beam and the seems of	50	0	178.5	8.7	 -
20 - 10 - 10 - 10 - 10 - 10 - 10 - 10 -	ا -				
	1		10	 - -	
	5P 28	9	110.C	1	99
200 or 1 to 01 \$134 (1AV 01 at 20.01	_			,	
- 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)1	1 (0)	**	g)	*
15 On Mar. D. brown, saturated,	- 1	10	11.5); 6	6.7
55 0 4 Trout brown, coarse grained,	SM	+			

GC71-28

SURFACE E

WATER OCCPTH FEET

-10 -10

BORING N			W G 27 Tot DRILL DATE 2/11/71
SURFACE	ELE VA1	19 MC1	09N.NG WEIGHT 351. N 10 r
MATER OCEPTH FLET	GRAFHIC SYRBOL	Rature Mean Petro (14 Table 19 19 19 19 19 19 19 19 19 19 19 19 19	CONTRACTOR CONTRACTOR
5		Mr. Pro Quillen, 1995 address for	
	nuii nuii	where priced, on the construction of the construction score of the construction score of the construction	199 🔘 40, 270, 60
▼ '5			10 101 101 101 101 101 101 101 101 101
-20	H	SHIP Complete National States	
25			
-30		SHITY CLAY Us gray to dark brown, more, wolf, trace of organic, of the more of organic, the more of th	(g. 1 to (1) 10 to 10 pt

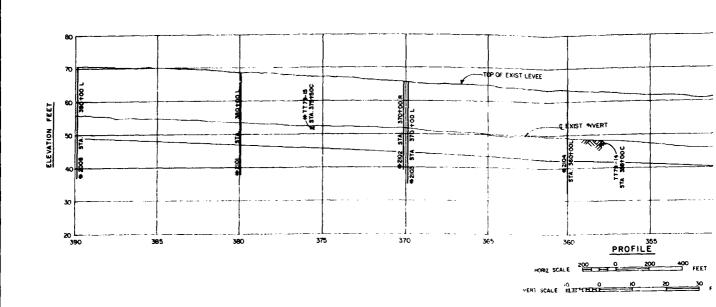
VALUE ENGINEERING PAYS GC71-25 GC71-24 GC 71-27 STATION 149 + 80 STATION 169 + 61 W.D. 22-164 DRILL DATE 3/10/71 BORING No. 26 W.O. 22-164 ORILL DATE 3/10/71 STATION 159 + 72 W.O. 22-164 DRILL DATE 3/10/71 BORING No 25 ROCATY N. DRIVING WEIGHT 500 lb., 18 in. SURFACE ELEVATION _ 76 WEIGHT 500 1b, 20 In. SURFACE FLEVATION 74 PRIVING WEIGHT 500 15. 20 in. GROUP SYNGOL.

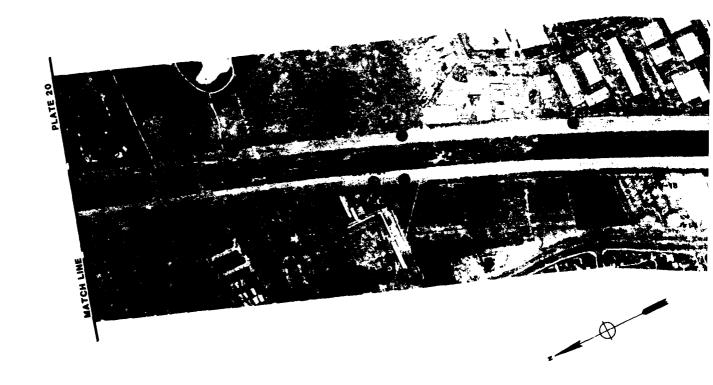
U.S.C.S.
RELE.R.S.ST.
RELEWS.T.
RELEWS.T.
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RELEWS.T.
COMPACTION Rotary Was - Borting; + Incl. Dirmeter Autary Warh Soring: 4 Inch Diameter. GROUP SYMBOL U.S.C.S. FEIN, RESST. BLOWS/FOOT CORE O BAB O DRY DENSITY BE! MOSTURE CONTERT NO. GROUP SYMBOL U.S.C.S. PER. RESST BR, OWS, FROT CORE O BAG O DRY CENSITY PET MOSTURE CONTERT % CONTERT % WATER ODEPTH FEET Rotary Wash Soring, 4 Inch Diameter Ę DESCRIPTION DESCRIPTION FILE: SILTY SAND: SH; brown, moist, Fill: SHATT SAND: SH; brown, moist, loose; trace of gravel. 100 FILL SAND SP; light brown, course Realmed, most, loose; scattered gravel and cabbles. 701 10 1 102.0 12. MATERAL GROUND: SARD: SP; brown, medium to coarse grained, moist, loose to medium derse; occasional thin scam of SUT: ML. 19 (105. MATURAL CREGUED; SAND: SP; gray, med.up grained, moist, medium dense. (1) | | | S'LT: SAND :::: dark brown, motst. 10--10 SILIN FINE SAND; ML; brown, damp, medium denne. 6 3 81.7 15 1 162.3 SATISTICS SATISTICS THAT CONTROL OF THE CONTROL OF coarse to make granted point, lorse, 9 ② 108.5 5.3 Pocket of GRAVEL; GF at 12.0'. ▼ 15 -15 -10 (101.0 87 18 10 10.1 V SAID: SP: light brown, coarse grained, 22 (3) 103.5 89 Silty CU'Y: OL; SAND: SP; SILTY SAND: SM; interbedded, wet to saturated, soft; organic. SILTY - 15D: SM; brown, medium grained, moist, medium dense. 6 3 27 @ 102.4 20.1 87 Ш 111 SAND: SF; brown, medium grained, moist, medium dense 20 (3) 10 0 26 (3) | 92.1 :9. 0 SILTY SALT: Six dark brown to gray, Story W: Ch. black, moist, stiff; 000 ... 29, ... F-12 01 WM73-4 LOG OF BORING 4 DATE CF BORING 24 Nay 1973 WATER CEPTH 13'

TYPE OF DRILL RIG Cont. Titcht Auger

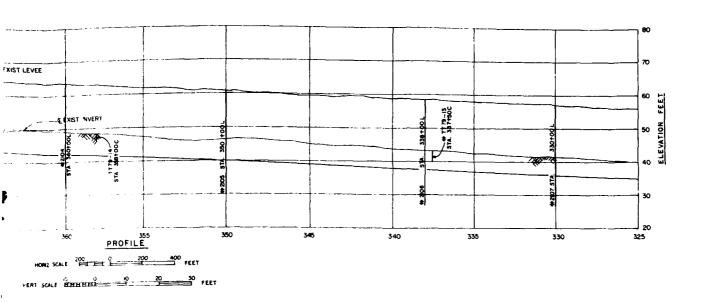
WEIGHT OF HAMMER 140 Ibs. FALLING 30" SAM DATE MEASURED 24 MAY 1973 GC71-29 C7i-28 UME, COMP STREAGH, 144 MOISTURE CONTENT, 76, DRY DENSITY ACT Wit 22-164 Drait DATE wo ?ii i seu san Bill DONING tre 22 STATION LIBY DU BANTLES BLOWS/TOOT GROUND WATER DRIVING WEISTLY THE ... Control of the contro OCOUP SWEETS
BLOWS/FTTTCORE D
BAG D
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BAG CONE TO SWEETS
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LENGT signs were really. A fact themselves DESCRIPTION WATER OCCPTH FEE GRAFHIC SYMBOL UNFACE ELEVATION: DESCRIPTION Dense, moist, orange-brown fine to coarse-grained SARD (SP) with CRAVEL and COBBLES Dark brown Hedium dense, with trace of CLAY and organic material cobt is at 2.00 94 Hedium dense, moist, light brown-orange fine-grained SAND (SP) 14.0 mod n strined, most, medic, donse, Becoming wat, with SILT lenses (SP-SN) 23 93 T Caving -10der . ti., of on, and . 15 0 100 Fine to coarse-grained (SW) 24 100 Sum: "I right brown merium to course praint f. set, donse. 244 1 132. 20 16* Bottom of boring at 25% ft. Poch for at 15 Will at 20.0" and 20.0" 25 30 SYMBOL 16 O 100 415 REVISIONS U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS *Driving weight under water SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM LOGS OF INVESTIGATION NOTES: BY OTHERS I. SEE PLATE 20 FOR TEST SITE LOCATIONS SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS. 2. SEE TABLES 4 STA.455+00 TO STA.390+00 SPEC. NO. BACW 09- ____ 8- ____

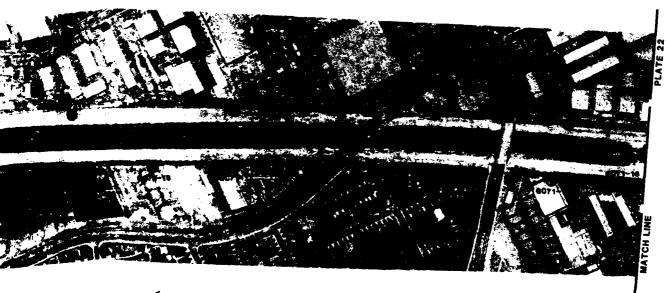
VALUE ENGINEERING





VALUE ENGINEERING PAYS





NOTES:

- I. SEE PLATE 8 FOR LEGEND AND GENERAL NOTES.
- 2. SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

				_			
SUMBOL .	Michigan		DATE	AFRICA			
	REVIS						
		U. S. ABMY BHGANE LOS ANGE CORPS OF BHG	ues .	3			
40040 M	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM						
250×1974 251	PLA	IN AND PROFILE					
060m In	STA.390	+00 TO STA.325+0	10				
RAMPIND SV.	DATE	SPEC MO. DACWOR		3440			
		MATTER TO PAR HID		1			

VALUE ENGINEERING P

TH 83-2101

N#3-2101			5	TA 380)+00 L			£1. 68±				
ept#	1.06	MC	u	Pl	4	-200		DESCRIPTION				
1.5	SM/SM	٠	_	140	94	7	25	SAME/STLTY SAMO: BROWN, MOIST, GRAVEL TO 3/8 INCHES, FIR TO MEDIUM GRAINED SAMO, I INCH LANGE OF MED. GRAINED SAMO				
	SPI	4		*	94	13		SILTY SMIT: SAFE AS ABOVE.				
4.0		10		10	100	17	16					
5.5	92	2			95	3		SAND: GREY, MOIST, MEDIUM GRAINED SAND-				
7 .0	SP/SN	1		P	100	10	9	SAND/SILTY SAND: SAME AS ABOVE-				
	a.	33	44	27	100	88		CLAY: BROWN, MOIST, FINE GRAIN SAND-				
] <u>.0</u>	1	8		-	100	<u>79</u>		SMOY SILT: SAME AS ANOME.				
1.5	<u>33</u>	27			100	<u></u>		SILTY SAND: BROWN AND GREY, MET, MEDIUM GRAIN SAND. SANDY SILT: BROWN, MET, FIME TO MEDIUM GRAINED SAND.				
1.2	S#	23		Ψ.	100	22	10	SILTY SANT: BROWN AND GREY, WET, MEDIUM SRAIN SAND-				
1.5	•	15		100	98	16	10					
-	•	51	38	ın	100	<i>7</i> 5	9	SAWRY SILT: RREY, MET, FINE GRAIN SAWD, IRON OXIDE-				
1.5		43	45	15	100	95		SILT: LIGHT GREY, WET-				
	SM	18		NP	100	27	10	STUTY SAND: GREY, MET, FIME GRAIN SAND-				
.5	SP/SM	19		₩	100	10	19	SAND/SILTY SAND: GREY, MET, MEDIUM GRAINED.				
د		17		NP	100	31		SILTY SAND: BROWN, HET, MEDIUM TO FINE GRAINED.				
	S#	23		۳	100	04		SAFE: LIGHT GREY, FINE GRAINED				
-5		19		WP.	130	73		SAFE - BROWN, MEDIUM TO FINE GRAIMED-				
	SP/\$M	23		140	100	16	17	SAMP/SILTY SAMP: GREY, WET, HEDILM TO COMISE GRAINED SAMP.				
	SH/SN	79		φ	130	12	19					

TT 79-15

INVER			\$1	TA 375	•50 C			e _{1.} . \$24
3€ ₽14	£96_	46	LL	₽1	-4	-270	*	DESCRIPTION
1.0	4	3			131	1		SAME: SAES, MOIST, VEGETATION, ERGUNDHATER AT 1-FOOT.

TH 83-2102

EL - 661			90 R	k 370	.02	THB 3-2102		
DESCRIPT	_	-200	4	PI	ц	HC.	L06	DEPTH
SILTY SAND: BROWN, MOIST, FE TO 3/4 INCHES-	_	18	96	IP.		5		
		39	96	*		10		
		24	98	. IIP		6	SH	
		18	98	MP.		3		
		13	96	₩P		3		Z: <u>5</u>
ZWWAZIFIA ZWIJ! FIGHL MICHI		9	97	#0		3	2P/2H	2.5.
STLTY SANTY LIGHT BROWN, MOI					_			4.2.
		14	190	*		4		
SAME - ROOM, MOIST, FINE TO		7	100	P.		1		
SARE: BROWN, TOTAY, FIRE TO							571	
		49	100	₩		19		
SAME: BROWN, HET, MEDIUM GRA		29	99	щP		16		9-0
SMITT CLAY: TANK GREV, MEY-		_ <u></u>	99	16	भ	52	Œ.	0.0
STILTY SIMP: GREY, WET, MEDIU		ŀŧ	19	₩2		ę		
		14	130	*		20	ć.	
								<u>3.5</u>
SAMMY STILT: TARK BROWN, WET, COMPSIVE.		56	130	ş	24	24	4.	
								6.5

TH 83-2104

						_				
HB 3-2	[04		51	A 960	+00 L			fi : 67:		
¥PTH	LUG	Mr.	11.	PI	-4	-200	H	ŋ€2Cbini		
	20124	5		140	92	7	75	SAMD/SILTY SAMD: BROWN-SREV. MEDIUM TO FIME GRAIMED SAMD.		
ų -Q		4		100	94	9				
5.5	50/54	-		#	97	6	34	SAND/STLTY SAND: BROWN, MOIS		
7:0	ØN/\$H	ķ		*	98	9		SAND/SILTY SANT: SAME AS ABO		
8.5.	Ze \da			100	97	,	77	SAMOUSILTY SAMO: SAME AS ABO		
		3		φ	99	1.8		STUTY SAND: "ROWN, MOIST, FI		
1.5		13	_	₩2	99	43	8	SME: RAGIN, MOIST, MEDIUM T		
 3:1	Ø				94	3		SAND: SREY, MOIST, MEDIUM TO TO 3/8 INDES		
4.5	19/5#	:		₩	97	5	10	SAMITY/SILTY SAME - SAME AS AS		
	n,p	5			83	2		FRANKLY SAND: SAME AS ABOVE		
Z- 5					62	4	13			
	50/5A	jo.		#P	92	,	15	SMINISTED SMIN: FIREY-LIGHT B BRAVEL TO T/B INCHES		
		18	· <u> </u>	₩	100					
4:0 6:5	1	a۱	32	9	l(A)	53	7	SANDY CLAY- DAME RINEY-BROWN		
W		F)	~	•	99	n		SHEW SILT- GREY, FINE DEAD		
	4	- 31		WP.	100	57	13			
	-	,,		_	100					

LUE ENGINEERING PAYS

TH 83-2102

	12	a 370	00 a			EL- 66±
MC	u	PŢ	-4	-200	R	Description
5		16	46	18		SILTY SAND: BROWN, MOIST, FINE TO MEDIUM GRAINED, GRAVEL TO 3/4 INCHES-
::		MD.	96	77		
5		W	95	74	25	
3		₩	38	18		
3		#	*	13		
3		4c	1.	3		SMP/S[LTY SMIT: LIGHT MICHAL MOIST, METILUM GRAINED.
		_			16	STUTY SAMED: LIGHT BROWN, MOIST, METHUM GRAINED-
4		Æ	1.10	14		
<u>Z</u> _		W	<u> </u>	3.	9	SAME: BROWN, MOIST, FINE TO MEDIUM GRALMED-
19		¥	130	49		
					9	
16		¥	9)	77		SAME: BROWN, WET, MEDIUM GRAINED-
V	1 17	ŢF.		∵ स्		CHINY TO THE CHEY, MET-
4		¥	к.	12		THE TY SMAN, SEEY, MET, MEDIUM TO CHARSE GRAINED.
27		¥	Ţ¥"	1-	13	
24	<u> </u>	•	135	7	6	(ABOY CT) T. DARK BROWN, WET, FINE TO HEDILM GRAINED, CONFEIVE.

TH 83-2104

	2.	1 360-	m			ন্ . 672
MC .] Y	•	JERCHIALION
₹		•	ī.		'n	SMB/SILTY SME. Brown-GREY, NOIST, FEW GRAVEL TO 374°, HEDILM TO FINE TRAINED SAW).
4		•	 94	· · · · · · · · · · · · · · · · · · ·		
3		•	27	,	4	SAID/SILTY SAID - BROWN, MOIST, HEDILM GRAINED SAID-
5		Ψ	·	1		SMID/SILTY SMITH THE AS ABOVE.
5			÷*	•	27	SMM/SITTA SMM. SME WE WOKE!
1		Ψ	'n	*8		STETY SAND - BROWN, MOYET, FEME OFFALMED SAND-
18		•	94	9.5	8	SME MOM, MOIST, MEDIUM TO FINE GRAINED SAND.
,)4 			SAND FREY, HOIST, MEDIUM TO COMISE GRAINED SAND, SPAYEL
5		₩.	37	5	19	SMITH/SILTY SMITH: SAME AS MEDICE, GRAVEL TO 1-1/2 IMDIES-
3			11	,		GRANTILY SMITH CAME AS MICHE!
			67	- 4	13	
20		Ψ.	₹	7	25	SMANSILTY SMAN SHEET-CLEAR BROWN, NOIST, MEDIUM TO COMPRE GRAMM, TO \$78 INCRES.
		_				
			190	·	7	
*8	32		130	54		SARDY (1,8Y) - PARK HITEY-BROWN, NET-
55		•	29	77		SMITY SILT- GREY, FIRE GRAINED SAVEN, SCHOOLY CONESTVE-
31		٠	190	57	13	
v		•	190	n		

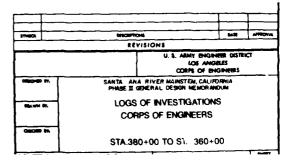
TH 83 2103

(HB3-21	103		ST	A 370-	100 L			£L · 66±
K PTH	LOG	MC	ц	PI	4	-200	N	DESCRIPTION
	SP/SN	•		1P	98	8		SAMD/SILTY SAMD: RAGAM, MOIST, MON-COMESTVE, PEN GRAVEL TO 3/8 INCHES-
4-0		٠		MP	99	8		SAFE: PROMI AND GREY, MEDIUM TO COURSE GRAINED SAND-
5.5	M.	19		NP.	93	62		SAMOY SILT: BROWN, MOIST, MEDIUM TO FINE GRAINED SAMO-
		14		₩	100	26	5	SILTY SAMD: BROWN, MOIST, MEDIUM TO FINE GRAINED SAMD-
	24	11		46	98	31		
3.0		19					7	
		5		Mb.	99	11		SMIO/SILTY SMIT: GREY TO LIGHT BRN, MOIST, MED. GRAINED
	SP/SM	3						SME: FREY-
4.5		5		₩	100	5		
	44	-3			100	14		STETY SANT: BROWN, HOIST, MEDIUM TO FINE GRAIN-
5.5 5.0	1	75_	75		100	- 28		SAMOY STLT: DARK BROWN, MOIST, FINE GRAINED.
	571	17		MP	100	46		SILTY SAND: BROWN, WET, COMESIVE, FINE GRAINED-
9-0_		28					20	
		19		MP.	95	57		SAMPY STUT: FREY, WET, MEDIUM TO COARSE GRAINED SAMO.
	M.	22						
3.5		24						SAME: DARK GREY, COHESTVE-
		28		NP	35	19		SILTY SAND: DANK GREY, WET, MON-CONESTVE, MEDIUM TO FIN
		24						
	SM	24						SAME: MEDIUM GRAINED SAMD-
		 25						
1.0								

NOTES

- I SEE PLATE 21 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTEO AS "IN VERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.





VALUE ENGINEERING P.

TT79-14

INVER	T								
1179-14	•		\$1	A 353+	00 C			EL. 482	
DEPTH	L06	₹(u	PI	4	-200	н	DESCRIPTION	
	9	4			98	0		SMID- Gery, entry,	
2-0					96	0		SARD: FIREY, MOIST- FROUMDMATER ENCOUNTERED	AT 7-FEFT.

T T 79 - 13

INVER	т						
1179-1	•		2	TA 337	50 r		EL. WAT
NEPIM	ر36	~	u	01	-4	-200	PESCRIPTION
	39	2			%	ì	SMD: GHEY, MOIST-
2:0 3:0	39/58			P	gr	11	SAND/SILTY SAND: GREY, MOIST. GROUNDHATER ENCOUNTERED.

TH83-2105

THB3-23	105		STA	350	+00 L			EL - 61:
DEPTH	L06	#C	п	P;	-4	-200	4	DESCRIPTION
1.5	39	1			100		 25	SAND- BROWN. HOLST, MEDIUM GRAINED SAN
1.2		3		T	100	9	"	SMIDY/SILTY SMID: SME AS ABOVE
	26/24	24		¥	100	6		SMF: For example to 1-1/7 INDES-
5.5		2		4	100	5		SME: CON GRAVEL TO T INCHES-
7.0	SH/SH	4		Ţ	100	3		SAMBUSTICTY SAMED: SAME AS ABOVE.
	3 *	6		¥F	;m	18	17	SILTY SAFFE: PROOFF, MOIST, FINE TO MET
9.5	\$75 1	-4		*	7*			SWEASILTY SWITE SINE IS MOVE.
0.5		3		F	170			CTETY SAPT: BROWN-GIVEY, MOTST, FINE .
2-0	SM	12		¥		15 	6	
		1_		. .	מנ	<i>:</i> .		SAND/SILTY SAND: BRN-GPEY, ≪€1. 457 **
		4		¢	9.7			SAME: SHAMEL TO 1 INCH-
		Π-		*	- 17	- -	11	
	26/34	14		ųc	33			
		12		φ	93	,	11	
		20		₩	ফ		11	
		20		1	[5)	·- \$ ^		
2.1	-	73		_	100	$=$ Ξ	•	THE SHEY, HEY, HERRIE GRAPE LAND
	39/ 3 9	20		MD	:0:			SWINT OF SME AS APPLE
25.0		23	_	₩	100		4	SAME - GMEY, MET, MEDILUM TO COMPRE 144
26-0	٠,	39	- 44	74	197			STLT- BARK GREY, FINE GRAINED SAND
27.5	sc	25	53	12	100	41	6	CLAYEY SAME! SAME AS ANOME.
- •a n	54	27	-	¢	190	49		STLTY SAID: SAIR AS MOVE-
8 5		3	71	п.				SHOW IT. BROWN, MET, FINE TRAINS
31.0	SM	21		*	90	:•		STITY SAME SHEY, NET, MEDIUM SPAINE?

TH84-2107

TH 8 4-21	107		•• •••				F1 , 575
DEPTH	Ł06	M(-4	יוני-	4	DESCRIPTION
, ,	34	;			15		SILTY SAMP, MINDER, MOTOT, LODSS, R. M. GRAMPL TO [77] INDMS, SOME CLIMMY OF CH
ان.اد	SH/SM	3		15	,	Į4	SAMINASILTY SAMITY: SAME AS ABOVE
						4	
9.0			 	34	4	4	SAMO: BAPMAI, MOIST, LOOSE, FINE WAINST CONESION.
	20					11	
15.0	~		ja	100	<u>-</u>	14	CARRY (LAY: DARK NAME MAILST CONESSIVE SAND, STIFF:
18-0	٦.		¥	180	ж	5	SAMBY SILT GREY, MYLLY, CONESTME, FIN STIPE.
21.0					•K		SILTY SMMD. GREY, MOIST, COMESIVE, FIN

₽ 100 🖦

ALUE ENGINEERING PAYS

TH83-2105

\$1	TA 3504	X 0 :		€1. 61.2
u	b 1		200	
		: 6		SAMP BROWN MOIST, MEDIUM G. AINEU SAMD-
	Ψ-	TT	7	CANTO CANTO SAME AS ANDRE-
	•			SUPE - Feli GRANG TO 1-1/7 INDIES-
	·			
	. ¥			OME SEW GRAVEL TO T INDIES.
	*			THIS IT THE AS ABOVE.
				TY SAMP MICHAEL MOIST, FINE TO MEDITH GRAIN SAND.
	*			1 to the administration state to agents another 2 miles
	· •-	14		WHEN TO CART SHE AS MIGHE
	- -	res est	7	THE BROWN SHEY HOLST, FINE GRAINED SAND.
	. .			ANT OF THE SAND BRIN-GREY, WET, WED TO COMPSE GRAINED SHIP.
	•			24 SHIMEL TO I TRICH-
	<u>.</u>	,,	-	
	-			
	*	22		
	 ♥			
	₩		•	
				TO MET MET PERIOR GRAINER SHIP
	•			AND STORY SAME IS ANOTHER.
•	₩			WE HET WET TO COMPSE GHAINED CAND.
a	r5 -		Y	THE SHEY FINE SHALVED CHID.
				AND DARK A LINE PROVIDED CAND
13		•		LAYER SHE AS MONE.
	•			T MY AS MOVE.
<u>π</u>	ni:			
24	- 44 − 1 Ψυ		•	MIN TY. Brown, SET, FIRE SEALURD SMIN.
	•	*		" "Y "AM" GREV HET, MEDIJH GRAINED SAND GRAVEL IN 1".

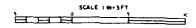
			ŢHĘ	14-2107
ma zeres		٠,	,	D . CTs Description
 •	••			** APP *** *** STEEL CODE. FIRE CRESSED SHED, FRU- WINDS TO TO SENES SOME TELEPOSITY CONSISTER SECT.
•				HI I THE REMAINS
				स्त्री जिल्लाक स्वारत । प्राप्त राम्ह प्रकासको प्रकार प्रकार पर्व एक
 .g. u.	i	-		MBDY TAY THAN SPINSE HONEY CHRESTING, FINE GRAINED HER CTEES
₩	,			APP 10 F SET ANT CONCINE, FIRE MAINED SHIP.
<u> </u>	- 'e'	٠		TO BY CART GREY, ROIST, CONTRIVE, FIRE MAKINGS SAID, STEE
•	'n			

TH83-2106

T#83-2	106		S	TA 335	3+00 L			EL. 59±
DEPTH	L06	MC	u	Pī	4	-200	1	DESCRIPTION
2.5	SPI	10		₩	97	18	18	SILTY SAND: BROWN, MOIST, FINE TO MEDIUM GRAINED SAND, GRAMEL TO 1-1/? INDIES-
	SP/SH	2		P	99	8		SAND/STLTY SAND: GREY-BROWN, MOIST, MEDITH GRAINED SAND.
5.5		4					11	
	S#	5		₩	99	13		SILTY SAID: GREY-BON, MOIST, FINE TO MEDIUM GRAINED SAND,
8.5		in		Ψ	98	18	4	SAFE: BROWN, HET. FINE TO MEDIUM GRAINED SAND-
	QP / SM	3		₩P	99	10		SAND/SILTY SAND: LIGHT BROWN, MET, MEDIUM GRAINED SAND-
12.C		4					7	
3.5	SM/SC	24	26	5	98	72	5	SILTY SAMD//LAYEY SAMD- PROMI, MET, FINE TO MEDIUM GRAINED SAMD-
	٦.	*5	33	2	120	87	,	SILTY: Brown, HET, COMESIVE
6-0 2-5	SM	71		*	98	18	8	SILTY SAMD: PROM, MET, MEDIUM GRAINED SAMD.
		34		Mb.	100	61		SANDY STLT: DARK GREY, FINE GRAINED SAND, SOME CONESTON
		13					5	SATE. THAT GREY, CONESIVE-
	4	11		*	100	63		SAME - LIGHT GREY, SLIGHTLY CONESTVE, FINE GRAINED SAND-
		!3	58	11	100	31	2	SAFF: Light grev, HET, COHESIVE.
4.5		4						
		27		₩	190	וי	11	CILTY SWY); "REY-BROWN, HET, "ENLIN GRAINEN SAND-
	9*	19		Ψ	100	18		
	-	77					::	
		~ -						
1.2		.7						

NOTES

- I SEE PLATE ZI FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE 84 FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



				
STIMBLE .	4807	NOM	DATE	MERCEN
	R	EVISIONS		
		U. S. ARMY BNGIN LOS ANGE CORPS OF BNG	LES	ici .
**************************************		NA RIVER MAINSTEM, CALIFO GENERAL DESIGN NEMORANG		
Statute St.	LOGS	OF INVESTIGATIONS	3	
	CO	RPS OF FNGINEERS		
000aio m.				
i	STA.35	58+00 TO STA.330+0	0	
- THE ST.	DATE			9487

GC71-13

		13	STAYION 76 + 37		W.O.	22-I	W1	_ De	140	الة. م	3/5/71 io in:
WATER	DEPTH FEET	GRAPHIC SYMBOL	Rocary wish boring: 4 Inch dismeres and 16 inch bucket auges DESCRIPTION		GROUP SYNBOL U.S.C.S.	PENE. RESST.	BLOWS/FOOT	CORE O	DENSITY	MCISTURE CONTENT 90	RELATIVE
4	- 0 -	HI.	SILTY SAND, SN; brown, medium to coarse grained, moist, medium dense.		_ sx	1					
	- 5 -		samey Silt, Mr.; gray, moist, firm, Silty Sami, St. play, fire to medium grained, saturated, loose to medium dense.		Tra. SM	F	•	0	-		
D	-10-		SANDY		_ C1 _ 5#]	-	છ)≀.́s	
}	5 -		Sill Journal Services to 189, 149, 149, 149, 149, 149, 149, 149, 14		SM	11		<u></u>			
	-20		Ch. a		Sı'	6		. <u>\$</u> .	-	32.5	1 1 1
· · · · · · · · · · · · · · · · · · ·				1.	-	_		· .			71-11-1-1

GC 71-14

		14		wo.	22-16	1_ GR	RL DA	TE 3/	9/71
SURF	ACE C	LEVAT	ion _ ?2	Dista	NC N	EICHT	140	1b .3	<u>-: 9</u>
WATER	ODEPTH FEET	GRAPHIC SYMBOL	Retary wash boring; 4 inch diameter DESCRIPTION	GROUP SYNVECTOR	PENE RESST	CORE O	DRY CENSITY pcf	MOIST URE CONTENT %	RELATIVE COMBINETION
			FILE SAND; SF; medium to course grained, moist, loost; clean.	SP		回	_		-
-	5 -				Ī	©			-
- ;	10-				12.	(C)		·	1111
4			SATISME OF CID: CLAYER FEW SAND, Mr. SELTY CLAY, C. SULT FEW SAND, Mr. interbooks			€ 		-	
	-20-					(i)	-		
-				- - -		0	· ;	. .	1.1.1.1.1.1.
_		101! 774		- '		-	.	!	_ +

SURF			···
WATER	SOEPTH FEET	SYMBOL	
	30 -	1	SAME TO
		9	SAND 1
			med carrie
	\Box	ļ.,	L
	J35 _	114	SILTS DE P
			fire
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GC71-16

BORING N.	16	Statine	,	wo	27-14	. DR	P. L. D4	ITE .	(B/T)
SUMPACE C.	<u>.</u>			DRI V		1:SH1	14	11 1	2 15
87.44 1114 FEET	5	CE ATTACH		CROUP STATES.	PETE PETE	378	06N 1 31	MCSTURE C. 47 ENT C.	1000
	Ħ	or growing to the fact broken.	Ιi	_ CL	1		1		-
4		who has a come, wet, to the of prayel			17	0	-	<u> </u>	
				,	11	0		† .	
-10-	ĮЙ	Service Service (Service)		-	 ,	0		_	<u> </u>
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	إلنا	My Table he was		ļη		0		-	
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GC71-17

nor.	₩	1.	STATIO	to SRIL PATE.
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	5		The training to the let	Control of the contro
#.47EP	1	SYMBEL	DESCRIPTION	ATIVE STATE
*	OCCPTH FEET		101 4 \$ sewie	\$ - 12 & 8 \$ \$ \$ 15 8 1 2 6
1		Ш	Fr his TV SAND has a tast to be	<u> - </u>
-	 		MATERIAL CONTROL SERVICE SERVICE STORY CONTROL OF THE SERVICE SERVICE SERVICE SERVICE SERVICES SERVICE	-
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L	- 5 -	1	Porket Figrave' at 5.05	{ -
V.	-			
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L	-10-			
1	-	H	and the state of the state of the state of	(11 99 - 1 61 -
1	-	111	No. 1 Contracts	
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-	13		Str., out la discorrison, more established	L
	\vdash			- °
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	-20-	111	SOURCE BOOK SHIP AND A SOURCE	0
		111	ាត់ស្តែក គេ គឺ ស៊ីតែ \$10 ខែ សង្គ្រា ខេត្ត។ សេស សេស	
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	\vdash	1111		
-	-25-	UH.	alous Southern Commission	0
L			atriate, remise ditie.	+
			* driver, sought under water	
	-30-			╟┊┼═┼═╎┼═┛
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	3 08i	NG N	.12.	
:	الماناة	ACE 5	11.00	1.50
	WATER	DESPTH FEET	GRAPHC	
	7	- 5 -		to a to
		- 10-		No. 1
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	-	-50-	11	Teachtra and a
-	-	- 25		ere rtement in the a
		-30		Per
L				

ALUE ENGINEERING PAYS

O 27-164 DRALE CATE 1/6

io

GC71-14 (Cont'd)

BOR	NG Na	_14_	STATION 81 + 78		w.o.	27-16	4_ DR	LL DA	Τ£ _1	/9/71
SUR	ACE !	LEVA	10N 57	,	DAIVE	46 W	CIGHT	140	16. 3	O In.
WATER	SDEPTH FEET	CALPHIC	DESCRIPTION		SOSO OBJUS ANDED	PENE. RESST. BLOWS/FCOT	CORE O	DRY DENSITY RE	MCISTURE CONTENT %	REL ATIVE COMPACTION
			SAND: Sr; brown medium grained, dense, grides to gray and brown Silly like, SAND; Sr; gray and SANDY Sill; ML, moist medium dense.	I,	- - 5P	15	0	•		
	15	\coprod	SiLTY 1175 SIND; SP; gray, wet, dense; grading to 5. NDY SHT, NL, brown, moise, firm.		ŠР Н	18	O			
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<u> </u>				t						

GC71-15

			STATION 87 + 34					ML GA		
SURFAC	3	LEVAT	ION _62	. 1	DRIVE	YG 1	EIGHT	ههد	ئے۔	<u> </u>
WATER	DOEPTH FEET	GRAPHIC SYN:BOL	Rotary with boring; 4 inch diameter DESCRIPTION		CROUP SYNAOL U.S.C.S	PENE. RESST. BLCWS/FOOT	CORE O	DRY DENS:TY oct	ROSTURE CONTENT %	
₹		unner	SAND, SP; brown, fine to medium grained, wet, loose; thin seam of Silty CLAY; CL; brown, wet, medium stiff of 2.0	il	- SP	6	©		-	
	5	ريزين درندند درندند	SAID ; SP; SILT; MU; SILTY CLAY, CL; interbundled, wet, soft.	Į	SP ML		0		37.0	
 - - - -	10-		SAMP, SP; gray, fine to reduir grained, net; loose,	L	SP	٠,	0	-	- 1	
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5		21.T Short, SM: gray brown, fin. to defend grained, wet, loose to section dense: Thin war, of <u>CLAYEY SILT</u> , Mi; brown, wet, firm.	-	SH	10	0	-		
- - - -	20-	14			•	ti	Ó		-25	
	25-		S. C. M. C. gree, moist, median tri. not-bodded with CLATER FIRE SAMPLES, wit, loose.		C.	8	0	-	اة.	
	,0.				-	-			- 1	-

GC71-19

встыз и	1.6	STATION LABLE 35.	wa	:2-16	<u>.</u>			4 ;
SUHPING :			ORIVI	NG W	rFitf	- J.		
MATE 4	GRAPHIC	Service of the Service of Service	GRILLO STABILL	BYLL RESET	CCGE C	1 5 Lav	MC STAR	harat Control
		Fj. (19 <i>97 <u>fATO, St.</u>) tel</i> Hove, outst, took to dervr) som pares of compete.	*					
Δ - ; -		My and the state of the state o	1 1 1 1	25	G.			- -
- 6		Mag. (E. laubt brown, or line grane), saferical, or fine grane).	-	174	Ģ	 ,, ,] 2-	· -
1			- - -	îe:	G	<u>,</u> ,,	; ;	
-20-	114	Thurstonic of the Garage Living Common Living The Garage Living Common L		19*	0	up 1	· · · · · ·	
0			<u>.</u>	28.	(j	w.c	16.2	-
-10		i Brising wilght u nder soles	F	~		-		-

NOTES:

- 1. SEE PLATE 21 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

SYMBOL			+	
STATE OF THE PARTY	REVIS	IONS	DATE.	MAGONAL
		U. S. ARMY ENGIR LOS AND CORPS OF EN	ELES	CT
50000FGD BY.	SANTA ANA P	RIVER MAINSTEM, CALIF ERAL DESIGN MEMORAN	DRIVIA IDUM	
DÉAWN ST.	LOGS O	F INVESTIGATION	1	
)	E	BY OTHERS		
G8088 9h				
ı	STA.390+	00 TO STA.325+0	00	
SUBMITTED SY.	DATE	SPEC. NO. DACWOP.		94907

GC71-18

8086	NG No	18	STATION	W.O.	22-16	d DR	LL DA	TE Z	y 11
SURF	ACE E	LEVAT	ION63			ÆIGHT	150		
WATER	ODEPTH FEET	GRAPHIC SYMBOL	Rotary wish boring: 4 linch diameter DESCRIPTION 35' E ¢ sewer	GROUP STARGE.	PENE. RESIST.	CORE O	CRY DENSITY pet	MOISTURE CONTENT %	RELATIVE
	- 5 -		FILL. SABP, SF, brown, medium grained, moist, ardium dense.	- st	1	0	101.	2),:	
_	-10-		SSST LINE to dark gray, wet, least to "line done."		-6	0	165.5	5.6	
7	-15 -		10 or 10 time or not.	- 51	134	0			
	-20-	· ·			10			22.8	
-	-30-		105 - Day Orivery weight - 105 - 10	-		(S)	96.3	2.3 \$	

GC71-18 (CONT.D)

URF	ACE C	LCVAT	ION _43	W O 27-164 DRALL DATE 3/9/71
-				OFFICE WEIGHT 100 16. 18 11
WATER	CEPTH FEET	GRAPHIC SYN:00L	DESCRIPTION	GROUP & W.SC. S. P. C. S. P. C. S. F. C. S. C. C. C. S. F. C. S. C. C. C. S. C. S. C. S. C. S. C. S. C. S. C. S. C
	- 30 -		SAND, SP; light to dark gray, set, loose to redium dense.	18 (6) 9 5 20 22 65
	_ 35		• 750 lbs. driving wight	
-			Andrew Transport Company of Company of Park	
ļ		-		
_				

GC71-22

BORIF	va No	. 23	374TION 129 + 26	W.O. 27-164 DIRL DATE 1 8 71
SURF.	ACL E	EVAT	ion '' _	ERIVING WEIGHT 10 15. 14 to.
WATER	OCEPTA FEET	SANIBOL SYNIBOL	DESCRIPTIONS L LOS COMPANIES	WOULD WGC USC DECENSITION CCC U BAS O CNT LTCO CNT ENT CNT CNT CNT CNT CNT CNT CNT CNT CNT C
			attle to the second term to the	57
-	- 5 -			
	-10-		Notice of a continuous of the second of the	
7	-15 -			
	-20-			12* (2) Inc. (4) (2)
•	-75-			177 (3) (0) (1) (1)
	-30			712 (3) 1144 9 40

GC71-23

BOP 12 No		with the second Assumation
SURFACE ELEVAT	on //	_ <u>(a. 1 </u>
WATER OS, FTH FEET CLARHOOT 'YARDAL	prochetion	
	481 - 481 - 183 183 - 183 - 183 - 183 - 183 - 183 - 183 - 183 - 183 - 183 - 183 - 183 - 183 - 183 - 183 - 1 Tantanan dia menjadah menjadah menjadah menjadah menjadah menjadah menjadah menjadah menjadah menjadah menjada	
5 - 11 11 11 11		
L.o. L	y <u>(1) (1) (30 y (30 y)</u> (30 y) (30 y) (40 y	- 50
7	pa + 50 <u>200</u> 200 tool 11	
-20	Service of an Meridian	
	"Mo, al., I. in brown, near. To votice transfer stands, standed, so the district dense.	511 78.4 e
	continued or next sheet	

ALUE ENGINEERING PAYS

18.0

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12-164 DREL DE'E 3/9/71

GC 71-20

Statt V	CE C	LEVA	rion	DR			EIGHT	50	9 16	7
WATER	T333 HT4300	STAPMIC	Rotary Wash Borton, 4 (nch Diameter DESCRIPTION	GROUP STARGE	USCS	PEHE. RESST. BLOWS/FOOT	CORE O	DRY DENSITY or	MOISTURE	CONTENT %
			SANDY clay; CL; dark brown, moist, soft.	-	CL					
Ā	. 5 -		SHTY CLAY, CL. gray to black, moist, soft.		ı	2	Ō	61.6	36.	0
- - - - -	10-	#	GAN: 5F, light brown, coarse grained,attention, widigs dense.	-	P	17*	0	102.0	22.	5
-	15 -			-			<u>_</u>		<u>_</u>	
	.2 1	· ·	Marin, Marin, Marin, Wale.	F		14*		he-,u		-
		 	from the or <u>sile (GA); CL</u> it 2).5°		SЯ	.,	(9)	95.	3	
		u iii	*Dank a wight under water	-	-	36*	<u> </u>	.,,		1

GC 71-21

		21						TE	
DURF!	ACE E	LEVAT	ION 55.5					16.	
WATER	ODEPTH FEET	TOBIVAS DIHAVES	Botary Wash Boring; 4 Inch Diameter DESCRIPTION	ORCUP STABOL U.S.C.S.	PENE. RESIST. BLOWS/FOOT	CORE O	DRY DENSITY pcf	MOISTURE CONTENT%	RELATIVE
			SAME, SP; brown, fire to medium grained, moist, loose, occasional thin ecom of <u>CLAYEY SD.T.</u> ML.	- - 5P	,	O	-	26.6	
4	Ť	icario Iraga		-	3	0		-	
	-10-		SAMP: SP; brown, medium to course grained, v-t, medium dense.	SP	12		·		
_	-15		SAMPY SHIT; HL; brown, wet.	HL	2	စ			
	~20-		SAND: SP, priver, and um grained, ser, medium dense.	- - sp					
	-			_ SP _ 6	16	O	-	-	
	-25	grid ini ini	<pre>SAMP, SP, STAY SAMP, SM; HAY GLATE CL intermolfed, wet, soft.</pre>	CL	5	0		34.2	
	-30.			-		-			_

GC 71-23 (CONT.D)

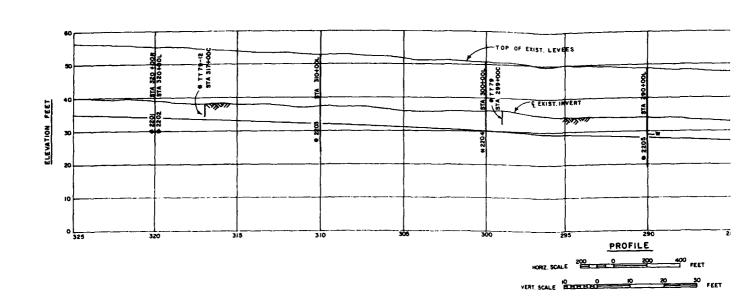
edikt ne 25 % (s) Station (190 + M)	WIG 27 HA DIRE DATE TELE
70% OF FECAN ON THE STATE OF S	ORIVING WEIGHT - 170
DESCRIPTION DESCRIPTION	C C C C C C C C C C
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Principle of Swatch	
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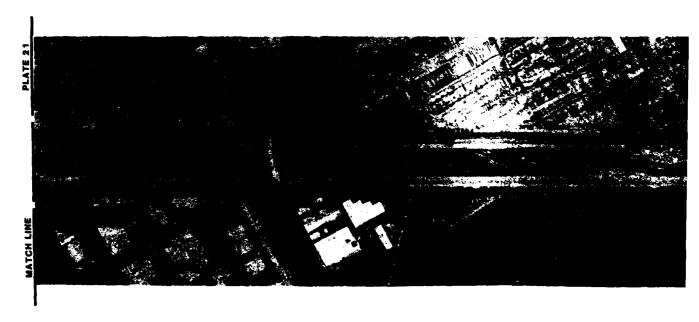
NOTES:

- I. SEE PLATE 21 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

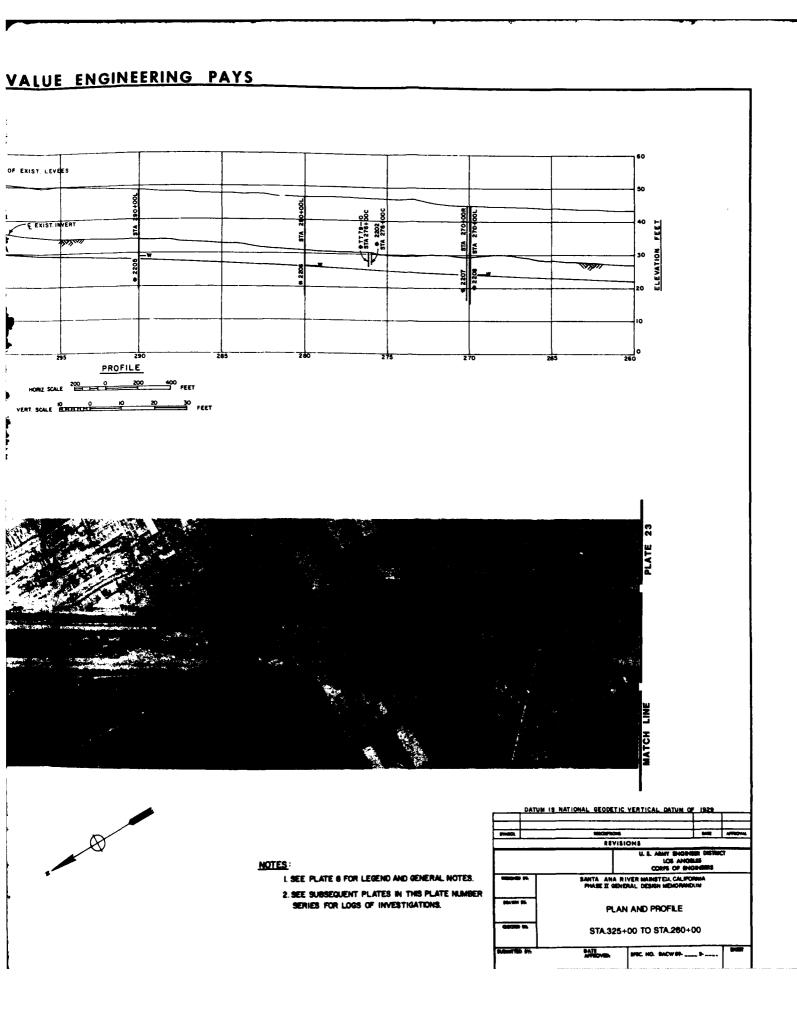
STRINGOL	esactoritores.	BAR	APPROVAL					
71.247	REVISIONS							
	LOS	INGINEER DISTR ANGELES OF ENGINEERS	ict					
1000-00 FT.	SANTA ANA RIVER MAINSTEM, PHASE II GENERAL DESIGN MEN	CALIFORNIA IOR ANDUM						
SEASON ST.	LOGS OF INVESTIGATION							
	BY OTHERS							
CARCINO IN	STA.390+00 TO STA	A.325+00						
-	DATE		914					

VALUE ENGINEERING PA









VALUE ENGINEERING P

TH83-2201

163-27	201		ST	A 320	00 R			EL . 961
EP TH	L06	IK;	ii.	Pl	4	-200	H	DESCRIPTION
	SM/SM	5		NP	82	g		GLMELLY SAMD/SILTY GRAVELLY SAMD: LIGHT BROWN, MOIST, MO CONESION, MEDIUM GRAVINED SAMD-
3.0	SP/SN			₩	95	6	27	SAND/SILTY SAND: SANE AS ABOVE.
3.0	31	-6-		- 10	100	15-		STOTY SMITH: LIGHT BROWN, MOIST, NO CONESCON, MED- TO PINE
<u>.a</u> _	0	78	21	8	100	87		CAY: BOWN, HOIST, SIPE CONESION-
2.0	571	9		۳	95	21		SILTY SMO: Norms, MIST, NO CONESION, OCCASIONAL GRANEL TO 1-1/2 INCHES: NEGAN ADDING DRILLING PLD DUE TO CAYING-
0.5 1.5	- 18	57	55	Z 4	100	₹		TILT: MON, CHESIVE-
L-2		V5		W.	94	ļq		SILTY SAND: LIGHT AROM, NO CONESTON, MEDIUM GRACH SAND.
	SM	15		*	199	29		SME: SME AS ABOVE WITH FINE GRAIN SAND-
		21		*	100	14		SAPE: SHOW, HET, MEDIUM GRAIN SAND-
8.0	-	38	45	15	100	64		SMEY SILT: BROWN, WEY, FINE TO HEDIUM GRAIN SAND-
0.0	CL.	29	35	11	100	55		SMENY CLAY: TANK GREY, WET, FINE TO MEDIUM GRAIN SAND.
2-0	sc	30	43	13	190	42		CLAYEY SAND: DANK GREY, MEY, FINE GRAIN SAND.
3.5		28			199	9	10	SAMPLETY TAND: AREY, NET, MEDIUM TO COMPSE SPAIN SAMO-
	59/54	30		₩	190	7		
9.C		77		-	<u>נעין</u>	14		STELL SHALE AS MEDIE.

TH84-2203

THB4-22	203		51	s 310	+00 L			FL. 53t
DEPTH	L06	TC.	T	01	-1	-200	*	DESCRIPTION
	9P/SN	4		*	38	,		SAND/SILTY SAND: LIGHT BROWN, LOOSE, FINE GRAIN SAND, STORE CLUMPS OF SILT.
<u> </u>					 .			SPLTY SAID: SAIE AS ABOVE.
							25	TICIT 3417: TARE AS ABOVE.
	54	5		40	39	v		
							5	
11					·			
							,	SIGTY SAME PROME, MOIST TO MET, LODGE, COMESIVE, VERY FIRE TRAIN SAME, STATE GRANGE.
		73		•	99	21		
							11	
	SP							
		34		-40	13	43	15	SME: LANGE CLIMPS OF STET.
		~		*	100	23		
1.0								
		99	51	\$	1,700	55	Ж	SAMPY SILT: GREY, WET, STIFF, FIMF GRAIN SAME, COMESIVE LARGE CLAMPS.
	4	-						
			31	4	100	52	20	
<u></u>								
	24			•	190	44		STI,TY SMID; SAME AS ABOVE.
8.0								

TH84-2202

THB4-2	202		s	TA 320	H00 L			FL- 56#		
DEPTH	L06	Æ	u	PI	-4	-200		DESCRIPTION		
.3.	SW/SP	4		•	98	9		SMB/SILTY SAMD: MINIMA, MOIST, LOOSE, SOME GRAVEL. TO PEREVROPETER TEST DUE		
_				`			21	SANT: SAME AS ABOME-		
	%	2			97	5				
							•			
9-0							5	SMB/SILTY SMB: LIGHT BROWN, MOIST, L GRAIN SAND, SOME GRANEL. BEGAN ADDING TO CAPTAGE.		
	SP/5M			P	99	5				
15-0							13			
	2 M			₩	39	14	ţţ	SILTY SMIT: LIGHT BROWN, MOIST, FINE COMESIVE, STHE SHAPEL.		
18-0_										
	SP/SH	ψŋ		₩	92	17	20	SUMP CLUMPS OF SMEY SILT, STIFF, COHES		
21.0	**	.79	 50	15	100	51	5	SMMY SILT: DARK GREY, FINE GRAIN SILE		
24.0										
	S*	£,	51	3	190	43	55	SILTY SAND: MACHIN, FINE SHAIN SAND, S		
27-0			•					SANDY SILT: SAME AS ANOVE-		
3 0.0	٩.		54	į	190	73	Į3			

TH83-2204

			<u>3-2204</u>							
1-83-27	n,		51	4 300	•90 L			P. 511		
DEPTH	£96	W.	U.	PI	-4	-200	Ħ	DESCRIPTION		
		•						SAMPUSILTY SAMP: PROMILISHT RESERVED TO THE INCHES.		
	PZ/WZ	1		₩0	100	ų				
		1								
9.0										
				*	fun	14		CILTY CARTY, PROME MAY GREY, HOTEY, FIRE TO MEDIUM GRAIN SAND, LAYEVED		
		ų								
	94	18			100			SAFE: PROUNT AND GREY, HET, FINE TO		
		15		•	Įno	13		SME: GREY, HET, HEDTIN GRAIN SAND		
		"		•	100	41		SAME: GREY, MET-		
23.5	1	28.		7	100	_3_		SMEY SLT. SMEY, MET, FIRE MAIN		
		75		IP	เขา	2		STLTY SAMD: GREY, MET, MEDITM GRAI		
	SH.							SAME: YELLING SH GREY, HET, HETIIM		
		21		ę	109	8		Ower: (Efficient St. Barga, and L' Lefolite.		
30 .5	7	78	- 35	17	100	79		SARRY OLD TO THE SARRY, MET.		

VALUE ENGINEERING PAYS

TH84-2202

:	5	4 320	₩ 0 0 L			f⊥- 56t
×c	u	PI	4	-200	N	DESCRIPTION
٩		100	98	9		SANE/SILTY SAND: BROWN, MOIST, LOOSE, FINE GRAINED SAND, SONE REAMEL. NO PENETROPETER TEST DUE TO LANGE GRAFEL.
					21	SANT: SAME AS ANOME-
2			97	3		
,					*	
	•				5	SWID/SILTY SWID: LIGHT BROWN, MOIST, LOOSE, FIRE TO COMPSE GRAIN SAWD, SOME GRAWEL. BESAN ADDING DRILLING MUD DUE TO TO CAPING.
F		*	39	5	13	
		1F	19	٠,	!'	S[1,17 SMM): LIGHT BROWN, MOIST, FINE GRAIN SAND, CONFSIVE, SYME SPAMPL.
.1		φ		1,	סי	SMIN/SILTY SMIN. LIGHT BROWN, FINE GRAIN SAWD, CHESIVE, STRE CLUPPS OF GREY SILT, STIFF, COMESIVE.
	 50	15	jm	53	5	SAMITY SILT: DANK GREY, FIME GRAIM SILT, COMESSIVE, SOME FIME GRAIM SAMO-
-	ŧį	?	in.	4)	*2	SILTY SANTI: "ROWN, FINE SPAIN SAND, SOME CONESTON-
	ţa .	1	; m	····	Įŧ	SAMOY SILT: SAME AS ANOVE-

TH83-2204

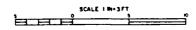
STA	₹00+	7.			Ft 512				
Li	9 !	. 4	-771	*	DESCRIPTION				
				-	SMM/SILTY SAMP: BROWN LIGHT BROWN, METHOM GRAIN SAMM MOIST, SHAMPL TO T/4 INCNES.				
	w 0	10	•						
	••	 ir	14		SILTY SART: "Herner and sarry, epist, "en conners, to \$/A", FIN' TO NEXT AN GRAIN SAND, LAMBRED SILTY SAND.				
		122	en		SATE: PRODRE AND GREY, WET, PINE TO MEDIAN GRAIN SAND-				
	•	100	14		CMT- GREY, WET, MEDIUM GRAIN SAMI-				
	•	199	3.		SIT: SHEY, MET				
		100	. 51		SMIT SILT: GREY, MIT, FIRE MAIN 1489-				
	•	190	,		STLTY SAMD: GREY, MET, MEDIUM GRAIN SAMD-				
	•	109	27		SAPE: YELLOW SH GREY, NET, MEDIN GRAIN SARD-				
5	17	(00	77		Sam fly: 687, 67.				

TT79-12

1T79-12	!		ST	TA 3174	0 0 C			EL- 38#			
DEPTH	L06	MC	ц	Pi	-4	-200	H	DESCRIPTION			
	9 9	13		_	99	2		SAMD: FIREY, MOIST-			
3.5					88	1		SAFE: FREY, HOIST, GRAVEL TO 374 INCHES-			
								GROUNDMATER ENCOUNTERED AT 3-5 FEET-			

NOTES

- I SEE PLATE 22 FOR LOCATION OF TEST HOLES AND TEST TRENCHES.
- 2. SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTEO AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



\vdash		DATE								
STREEGY	FRIEDL MIGURIO4									
	REVISIONS									
	U. S. AMNY BYGGRES LOS ANGEL CORPS OF BYGG	8	3							
2000 SY.	PERCHED 87. SANTA ANA RIVER MAINSTEIL CALIFORNIA PHASE IX GENERAL DESIGN MEMORANDUM									
GOAWAY DY.	LOGS OF INVESTIGATIONS									
ł	CORPS OF ENGINEERS									
STA.320+00 TO STA.300+00										
	APPEOVED MEC. NO. DACWOR.	_	91007							

VALUE ENGINEERING F

TH83-2205

WVER 1179-1			5	TA 299	• 0 0 C		П	79-∐ ε. %±
DEPTH	L 0 6	枚	Ħ	PI	4	-200	1	DESCRIPTION
	5P/SH	•		P	95	,		SAMO/SILTY SAMO: BROWN GREY, MOZST-
3.0 4.0	31	77		P	100			STLTY SMID: RLACK, MET- GROUNDMATER ENCRUPTERED.

THB3-2205				STA 2	90+00 L			EL- 49±
_	.06	MC	и	P	4	-200		DESCRIPTION
1-0	CH	20	69	T.	100	73		SANDY CLAY: BANK MINDRE, ASPHALT CHEPS-
		4					19	SILTY SAND: LIGHT BACHN, FON GRAVEL TO GRAIN SAND-
		4		*	100	13	•	SATE: SAME AS ABOVE HETH LESS GRAVEL.
:	S#I	4					2	
							5	SAME: LIGHT BROWN, NEDIGH TO COURSE GRA- LIBES OF GRAMPILLY SAME, GRAMPIL TO 378 INC
		17		φ	100	45	7	SME: BROWN, MOIST, FINE TO MEDIUM GRAL
6.0		<u>a</u> .			100	- N		SAFE: BROWN, MEDIUM SRAIN SAND-
7-0 m (G.	28 14	27		100	- []	5	SHETY STLT/SMEDY CLAY: DARK BROWN, FINE SILTY SAND: BROWN, MEDIUM GRAIN SAND.
20 0		38	48	23	100	65	9	SAMEN CLAY: DANK MICHIN, MET, MEDIUM TO
		23						
LO		75	43	71	100	יָז	7	SAVE: SREY, WET, IRON OXIDE, FINE GRAIN
		25		*	109	29	6	SILTY SMIT: SREY AND BROWN, MET, MEDIUM SMID-
24	•	 z:		y p	100	27	20	SAME: MROWN, WET, FINE TO MEDIUM GRAIN
.0								

						III	84-2282
182		\$1	A 275	•00 C			FL - 90±
L05	*	ш	Pİ	4	-200	,	Description
9				94	;		SMR: PULYICOLORED, NET, FOR GRAVEL TO 1/2 INCH-
					_		
591			NP.	95	12		STLTY SAND: DARK GREY TO BLACK, NET, FIRE TO METILING GRANNING SAND, SOME CONSTIGN. HIT RIP-RAP AT 5 FT.
	105 105 3°	162 1.05 Pc 5P	\$2 SI LOS ME LL 5P	#2 STA 275 LOS *C LL P1	\$2 STA 275+00 C LOS PE LL P! -9 5P 99	#2 STA 275400 C LOS PC LL P; -4 -200 99 94 5	92 STA 275-00 C LOS - NC LL P1 -4 -200 N SP 94 3

INVER	T	<u>T.T.79-10</u>													
1179-1	3		51	4 275	•00 C			વૃ. જા•ુ							
DEPTH	rue.	MC.	(L	91	4	-200	11	DESCRIPTION							
	9P/9N	3		ø	25	5		SMIN/STLTY SMID: GREY, SOME GRAVEL TO MATER ENCOUNTED AT 3.5 FEET.							
_اند															

VALUE ENGINEERING PAYS

TH83-2205

	\$1	A 290	• 0 0 E			EL- 49±
	u	PI	-	-200	1	DESCRIPTION
3	69	H	100	73		SAMEN CLAY: DARK BROWN, ASPIART CHEPS.
•					19	SILTY SAND: LIGHT BROWN, FEW GRAVEL TO 1 INCH, MEDIUM GRAVE SAND-
_						SAVE: SAVE AS ABOVE HETH LESS GRAVEL.
•		P	100	13	4	
•					2	
					4	SAME: LIGHT BROWN, MEDIUM TO COMPSE GRAIN SAMD, 1 " LINS OF ORAMELLY SAMP, GRAMEL TO 37R IMDIES."
F		Ψ	100		,	SINE: BROWN, MOIST, FINE TO MEDIUM GRAIN SAND-
,		P	100	ज		SAME: BROWN, MEDIUM GRAIN SAMD-
8	. 27	1.	186	12	i	SHOTY SILT/SHOTY CLAY: DANK BROOM, FINE GRAIN SAND- SILTY SAND: BROOM, HEDITAR GRAIN SAND-
8	48	23	100	65	4	SAMOY CLAY: DANK BROWN, NET, MEDIUM TO FINE GRAIN SAMO
₹-						
	43	71	100	ņ	,	SAME: SOEY, MEY, IRON ONTHE, FINE GRAIN-
;			100	. — .*1	s	SILTY TANTO- GREY AND BROWN, WE'T, MEDIUM TO FINE GRAIN SAND.
			100	····	79	SAME - GROWN, WET, FINE TO MEDIUM GRAIN SAMO.

<u>T 79-10</u>

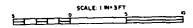
	57/	2/54	9 0 5			ન્. જી≵
₹	u	Pţ	-4	-200	•	Description
3		•	*	5		SAMOUSH IT SAME. REEV. SOME GRANTEL TO 1/2-INCH. GROUND-HATER ENCOUNTED AT 3.5 FEET.

TH83-2206

THB 3-22	36		ST	A 280+	0 0 L			EL- 47±
DEPTH	L06	MC	u	PĮ	4	-200	*	DESCRIPTION
	SP 1			ИP	100	29		SILTY SARD: BROWN, MOIST, GRAVEL TO 1/2 INCH. MEDIUM GRAIN SARD, & INCH ASPHALTIC CONCRETE PAYING.
3.5	0		79	9	100	53		SAPPE CLAY: BECOME, MOIST-
				MP	100	22	21	SILTY SAND: BROWN, MOIST, CLAY CLODS, NEDIUM TO FINE GRAIN SAND.
	S#			#P	100	19	12	
				ИP	100	16	5	
12.0		7		NP	100	14		
13-0	997SH	7	_	10	100	12	9	SAND/SILTY SAND: GREY AND BROWN, MED- TO FINE SHAIN SAND
15-0	Ħ,	24	32	3	100	56		SMITY SILT: TROUG TO DARK BROWN, FIRE BEASM SAND-
	591	23		HP	100	50	9	STLTY SANTS: RACHEL TO DAME MADINE, FINE GRAIN SAND-
18-0		34	40	14	100	82		SMITY SILT: DARK GREY, DREAMICS-
<u>₩ 21.</u>	o 4.							
		43						
29-0							-	
	SM	78		咿	190	71	9	SILTY SAND: GREY, WET, MEDIUM GRAIN SAND-
28-0		26					14	
30.0	a .		42	20	190	92	g	SAMITY (I, AV: SHEY TO DAMM GREY, MET-

NOTES

- 1. SEE PLATE 22 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTEO AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.



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			-	APPROVA
STREETS	REVIS	10111		
	KEAIS			
		U. S. ARMY ENGIN		a
l .		LOS ANGI		
1000000 17.	SANTA ANA F	RIVER MAINSTEM, CALIFE ERAL DESIGN MEMORAN	DUM	
1				
		ATION	-	
	LOGS O	F INVESTIGATION	13	
! }	CORP	S OF ENGINEERS		
G0000 W				
(i	STA.299	+00 TO STA.276+	00	
\	DATE			900
SCHOOL IN	APPROVED	SHIC HO. DACHOR	P)

VALUE ENGINEERING P.

TH 83-2207

THB3-27	107		2.	TA 270	+00 R			EL. 45±
DEPTH	L06	MC	ц	Pţ	4	-200	N	DESCRIPTION
								SILTY SAND: BROWN, MOIST, MEDIUM GRAIN SAND, GRAVEL TO 3/8 DROSES
	SM	5		φ	100	16	21	NA IMARA
4.5		8		NP	99	27	7	SAME: BROWN TO DARK BROWN, MOIST, I INCH LAVERED CLAVEY SAND, FIRE TO MEDIUM GRAIN SAND.
6-Q	CL.	26	49	?5	100	65		SAMOY CLAY: BROWN TO DANK BROWN, MOIST, MEDIUM TO FINE SHAIN SAMO, PLASTIC-
8 -0	SC	5	37	19	100	13	6	CLAYEY SMID: BROWN AND GREY, MOIST, MEDIUM TO COMPSE GRAIN SMID, GRAVEL TO 3/8 INCHES-
<u> </u>		9		1P	98	19		STETY SAND: "MYNN, MOIST, MENUM GRAIN SAND, CLAY CLODE
	SM							SAME: NO CLAY
2.0		5		•	99	13		
	SMSM	5		₩.	100	12		SAND/STLTY SAND: SAVE AS ABOVE-
4-0		13	27		99	48		STLTY SAND: DANK PROMI, HOIST TO WET, CONESIVE-
	211	8		HP.	99	14	5	SAME: LIGHT SHOWN, MOIST, MON-CONESIVE.
7-0							,	
• •	SP/SM	16		•	130	,		SMIN/SILTY SMID: BROWN, WET, MEDIUM TO COARSE GRAINED SMID.
9-0		36	45	18	100	76	3	SANDY STLT: GARRY, MET, PLASTIC, ADDED DRILLING MUD TO REQUIDE CAVING.
	٨.	 34	34	8	100	97	,	STLT: TROOP AND GREY, SAME AS ABOVE-
				-		-		
5.0	ক্ৰম্ম	29		-	191	10		SMIT/SILTY SMIT: SREY, FINE GRAINED SAND, NON-CONESTVE-
	CH	53	50	23	100	91	3	CLAY: SREY, PLASTIC.
8.0	- 51	77	য়		100	- 57	10	SILTY SAMD: BROWN, CONES PVE

TH 83-2208

THB3-221	08		5	TA 270)+00 L			EL. 45±
DEPTH	LOG	ΝC	Ц	PI	-4	-200	*	DESCRIPTION
-			_					STLTY SAME: RICHMI, MOIST, CLINY DUTIES, MEDI-
		5		Ψ	100	91		
	SM	8					12	
9-0		10		φ	100	43	۵	SAME: BROWN, MOIST, FINE GRAIN SAND.
12-0	α	11	39	3	100	52	8	SAMPY CLAY: BROWN, MOIST, FEWE GRAIN SAMO. CLODS.
	SM	ų		φ	ln.	27	4	SILTY SAYD: BROWN, MOIST, MEDIUM TO FINE GR SOME CLAY OLOOS-
5.0	r.	27		40	130	74		SMITHY SILT: SAME AS ABOVE.
6.5 Z.0 8.0	(년 92/5년	7 <u>q</u> 75	50_	25	100	87	9	CANTO TAY: ROME, MOIST, IRON ONITE, ORGAN
<u> </u>		48_						ELAY: ROOM AND GREY, WET, MEDIUM GRAIN SAN
N 50 0		41	4?	27	in	85	8	SAME: GREY, MET, ORGANICS
		79					7	
	n							
		29	45	32	190	43	à	SAMTY CLAY: GREY, WET-
		76	34	;,) (In	55	10	SATE: PROME AND GREY-
u-D								

UE ENGINEERING PAYS

TH 83-2208

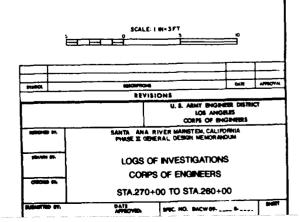
0 L			FL- 45\$
4	-200	*	PESCRIPTION
			STETY SAMP. ROOM, MOIST, CLAY CLODS, MEDIUM GRAIN SAND,
100	v		
		:'	
00.1		э	SAPE RROWN, MOIST, FINE GRAIN SAND-
nn	57	;	SAMPLY (LAY BROWN, MOIST, FINE GRAIN SAMO, SOME CLAY 2,005.
	••		CLT SMT): PROM, MOIST, MEDIUM TO FINE GRAIN SAND, 599F CLM CLODS-
JD	74	q.	CHINY STITE AS MOVE-
-		7	CHANGE TO SHE AS MOUNTE, CHECKELLE.
			CAY ROOM MY GREY, MET, MEDIUM GRAIN SAND-
m	45	,	CAME SHEV, HET, ORNANICS-
		,	
10	4.	٠	SAMETY CLAY - FIREY, MET-
	<u>-</u>		
199	44		SATE PRODUCED SPEY.

TH 83-2209

THB3-22	109		ST	A 2604	6 0 L			된. 44 2
DEPTH	LNG	MC	U,	ΡĮ	-4	-200	×	TRESCRIPTION
		6		No	gŧ	14		SILTY SAMD: RROWN, DRY TO MOIST, MEDIUM GRAIN SAMD, OCCUPAND JAMO STORY.
	SM	10		100	100	16		SAME: LESS FINES, FEM CLUMPS OF COMESTVE MATERIAL-
5-0	SH/SM	•		IIP	37	11	21 9	SAND/SILTY SAND: BROWN AND GREY, MEDIUM GRAIM SAND-
3.0	n,		٠,	13	100	55		SAMMY CLAY: BROWN, WET, LAVING OCCUPRED-
13-0								
15-0	۳.	32		40	100	87	5	SILT: MRYMM, WET, METILM GRAIN SAME.
	a.	39	43	18	100	87		CLAY: BROWN, WET, MEDIUM SPAIN SAMO, SIME PLASTICITY
18-0	a			Ψ	100	19		SILTY SMID: PROMI, NET, MEDIUM GRAIM SMID, GRAVEL TO 3 INCHES-
<u>20-0</u> 21-0	T.			- NP	רוין"	74	6	SAMIN SILT: FREY, NET, TRACE OF IRON OKIDE-
	n.	31	42	ייץ	100	54		SAMPLY (LAY: SAME AS APOVE)
25.5	571			wp	100	75	11	SILTY SAYD: BROWN, WE'T, WITHIN THAIN SAYD.
	ď	42	24	18	100	92		CLAY: GREY, MET, TOACE OF IRON CIXINE-
29 .0	٦.	3C		₩	100	79	11	SAMITY STUT: PROMIL GREY, FIME GRAIN SAND-
1.0								

NOTES:

- I SEE PLATE 22 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAMITED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.



VALUE ENGINEERING PA

GC 71-3

		1					_		TE V	
URF	KE C	LEVAT	ION	DR	VIN	G W			<u>ь, зо</u>	
WATER	DEPTH FEET	GRAPHIC SYMBOL	Flight super and hollow stem super 4 Inch dismeter DESCRIPTION	CHOUP SYNED	C.S.C.S	PENE RESST BLOWS/TSOT	CCRE O	ORY DENSITY pef	MOISTURE CONTENT %	RELATIVE
	- 0	111	SILTY SUD. SM. brown, fine to medical grained, moist, loose, saturated at we feet.	- 59		6	0		18.5	
4	- 5		SILTY CLAY, Cl., brown, valurated soft. Interfeeded both CLAYFY SILD, 11, brown,	-	_	1	Q	-	35.0	-
			saturated, wift, traces of decord: rootlets.	11	i.		} }			
_	10-		saud (P. brown, Fine praised, saturated, loose, medicions	 -	r	٩	ര	1	36.2	1
	-		SILTY clay; cl; brown to kray, ser, section or of three-bodes, sert clay; SILTY ", Securated, soft.		:: \		(3)	-	-	
	-15	111	SATE to began bet, a con terminate of the sate of the	=			9	-	33.	
	-50-		SAND SC. Top, to dain crasmin, saturass I, teder Sc. se	1 1 1 1 1	5.9	:	-			
	5	-		1		! ~		-		
	30	<u> </u>				:		-		

5	URF	cc c	LEVAT	104
	WATER	ODEPTH FEET	GRAFHIC SYPBOL	2016
	-	- 5 -		1/1
	4			<u> </u>
	-			<u> </u>
		15		
	-	-20	1	1
			- - -	
	 -	-		1
	_			

GC 71-6

BORING No 1 STATION 30 STATION 30 STATION 30	36 WO 22-154 ORB L DATE 3/3/71 SERVING WEIGHT 3/4 15 12 in.
Rotaty wash boring; 4 th and 16" burnet DESCRIPTION	GROUP FIREC. U.S. S. S. S. S. S. S. S. S. S. S. S. S.
HAT THE CASE SEA TO AND SEA AN	and turn to conditions defined a
HAN DO NOT BE MADE TO A	Disch work,
Sept. My Ca Record. Sept. My Ca Record. The lawer of Sill M.	and two graphs d
20	1 3
Sign Clay Ct. brownish soft to modium stiff Sign; SP, light brown, se	from to coarse,
-25 will me, vir dense. Addressing writis under	

GC 71-7

	IG No.		STATION 18					
SURF	SURFACE ELEVATION 3							
WATER	ООЕРТН РЕЕТ	SYMBOL SYMBOL	Retary was a constant of the age of the constant of the consta					
	t°1	11.1	SILTE OF STATE OF THE STATE					
1	$\overline{}$		gtaife					
4		111						
	Ы	1//	\$1 <u>1.7</u> 10					
		7.77 [[[] 7.77	realist with 1987					
ļ	Ł., I	111	}					
1,	۲'°	Ш						
-								
-	113-	1	\$550 gr up 5 7 5 7 5 7 5 7 5 7 5 7 5 7 5 7 5 7 5					
			Short and the state of the first term of the first term of the state o					
1	-	V///	General at the fact of the party of the					
F	-20-	lin	<u>"</u> .					
1	<u></u>	111	ł					
ì	} —		1					
1	-	1	}					
1			j					
-	1.50	}	SHITE AND S. Brown, 1500, No. 1					
Į	-	litt						
_	T-	1	1					
- (F	ł	Metaling weight mores with					
1	}	1	1					
E	-30	Ŀ	<u></u>					

LUE ENGINEERING PAYS

10 77-164 DALL DATE 1 . 71

- CE U (3)

GC 71-4

		4	STATION 19 + 83			EIGHT				
WATER	ODEPTH PEET	GRAPHIC STREDL F	Return varia boring, 4 tack diameter DESCRIPTION 50' M & rever	zl.		COME O		핗	MC:STURE CONTENT%	RELATIVE COMPACTION
			SAPINY CITI, Mg., brown, moist, soft.	- _HL -	,	0	98.	٥	18.2	-
4			SAND, SE, light brown, course to measure, asturated, loose.	sp						-
-	- 0-		Situating a monthly CL and SAND, SP, approximated, were fire	HIL CL	,	อ	81.	5	36.0	70 -
	. ;5 ~		SAN OF Light become to be use, fine to consider a continued uses to very dense.		14.	O)	-	. ! 	ىد, ئۆ	+ -
	-20-			- - -	-3	0	iei		-3-8	44
-		;!! :::::	Anita and Mark 5 - He f Home was	- 5		<u>৩</u>	.0.	-		-
				-			-	 - -		

GC 71-5

	NG No.			W.	02	2-16-	4_ DR	LL DA	TE 3/	5/71
SURF	ACE E	LEVAT	10N _3?	DR				140	lb.)) ic.
WATER	O DEPTH FEET	CHAPHIC	Kotary wish boring, 4 lach diameter. DESCHIPTION 10' E L, «ewer	GROUP SYNBOL	U.S.C.S.	PENE RESST BLOWS/FOOT	CORE O	ORY CENSITY pet	MOISTURE CONTENT %	RELATIVE CUMPACTION
V			adff) (NN), SM, troval medium grained, locally knitce, morit, medium dense; 2 rolls aum of medium triff clay at 2".		ч .я	12	_		16.	
-	5 -		Stirt GLAT, CL; brion, wet, soft; interbedfid with 1186 SAME, SP; intotated, loose.	1	CL SP	8	3			
,	-10-			-		4	0		ŧ.	
H	.,,		SHITE of C. Ct. grazish-hrom, wet.			7	O	-	37.	-
	-20		to the terrutar primed, well-to-water draw, scattered grave	-	SP	23	<u>ে</u>	-	1	-
_			<u>S</u> 'Z' - 1,, <u>1,,</u> b., + m, t, setf:	<u> </u>	_	- 5	0		\$	
-	-30-	1/	ere ere ere ere er under det ere ere ere ere ere ere ere ere ere e		-					-

GC 71-7

BOYEL S	STATION IF 14"	WO 72-164 DRILL DATE 1 1/1/2. DRIVING WEIGHT - 1 10 - 2 - 22 - 22 - 22 - 22 - 22 - 2
******	de tempes	USCS DESCRIPTOR BLOWS FOOT CORE O BAG DITE TO CORETTY CONTRICTY CO
	Storm, Mariam to Ermesa Di re - Dië, sedimm den e	
		11** (1) No. 1 2 19 70. 61.
• 1//	ļ	
	the state of the s	# (1) 9 · 1 /2 · 6 · 1
	*-	n Q n n 1 n
	143 syp. 3, how, flor, selet	SM 257 (3) 101 5/25 80
-30	*Ariv.on wright outco water	

NOTES

- I SEE PLATE 22 FOR TEST SITE LOCATIONS
- 2 SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

STMBCIL	MINISTROM.		ATE AFFROY
	REVIS	IONS	
		U. S. AMNY ENGINEER (LOS ANGELES CORPS OF ENGINE	
9880°90 57.		RIVER MAINSTEM, CALIFORNIA ERAL DESIGN MEMORANDUM	\
	LOGS	OF INVESTIGATION	
		BY OTHERS	
0000 P.	CTA 22	25+00 TO STA.260+00	n
		3+00 10 31A.200+0	U SHORE
9J8H4F790 6Y.	APPROVED	SFEC. NO. DACWOF	
		COUNTY BILLION	- 1

VALUE ENGINEERING PAY

GC71-8

	NG No		STATION 46 + 31	W.O.	WHG W	4 pr	500	18.20	
MATER	DEPTH FEET	GRAPHIC SYMBOL	Potary wash boring: 4 inch diameter a-d 18" bucket auger. DESCRIPTION 100' U E sever	GROUP STABOL	PENE. RESST.	CORE 0	DENSITY pet	MOISTURE CONTENT %	COMPACTION
▼	5 -	主 学生 "三"	SILT SAMP, SN brown, fine to medium grained, mairt, medium dende. Thirty interhedded layers of very fine SAMP; SF; and SILT; ML;		1	0	ورو	27_1	
A	-10-		SANT N.T. M. pray, saturated, soft to firm, nucrebodied with SAND, SF, Bray brown, saturated, loos.		P*	3	95.2	<u>14u</u>	51
	15 -]]			Pa	O	78.4	4,5	1
	-zo-		SILTY FIDE SAME, ME. Light brown, saturable ordina dense to dinne.	- %	22	9	65.0	29-1	
-	-30		Control of the state of the sta	, sc		O	RE.S	-	

GC71-9

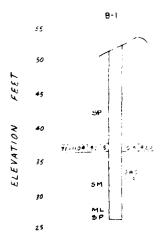
	IG No		STATION 52 + 28	W.O.	72-16-	- 06	44.08° 500.	16. ¹ /	6/71 7 15.
WATER	O DEPTH FEET	GRAFHIC SYMBOL	Rotary wash boring: 4 inch diameter and 16" bucket auger DESCRIPTION	GROUP SWIBC.		SAG CORE		MOISTURE CONTENT %	RELATIVE
₹	- 5	ni m	SILTY SAND: 31 brown, coarse to fine grained, wet, loose to medium dense; eathersted at 2.2.	7	Pas	1	-		1 1 1
	10-	111 111		r 	16*	Œ	06.3	29.0	95
1	-15 -	in u				ව	,		
			SILTY CLEY, Cl.; grayesh-brown, moter, ecft.	- -	6.	0	103.	27.0	8e _
	-20-	的证此	SHIR Style See light from, fire grained, set, seeding dense to dense. Thin layer of CLATTY fit 5 Mg, at 13.15	- : *	9-	0	108	24	85
	-25-	Ű	*driving wright midra vater.		16.	Ø	iir.	21.	,,-
	-30-			IE_		<u>_</u>		-	

SUFFF	IG NO ACE E	LEVAT	STATE
WATER	ODEPTH FEET	GRAPHIC SYMBOL	Rotary was bern and 16" binket DESCR
	F-	111	STITE SATE
١		111	
V,	- 5 -	111	Saturate 1 :t
	<u> </u>		
	-10-		SAND THE CONTRACT
~	_		
_	13-		
	-20-		
		罹	int to add the
		///	
	-25-	7/7	1868, 1877 B
	30.		
	<u> </u>		<u></u>

GC71 - 12

URFAFF	ELEVAT	ICH LEE	0	WEV)	46 A	EIGHT	1700 1700 1804	۱۰. ۱ الــطن	-10
OCEPTH FEET	ST7:BOL	RUDIN WISH HOTIME, - Inch disector and it unch business and its control of the co		JSC 8.	FENE. RESST BLOWS, FOOT	COME	DRY DENSITY act	ACISTURE CONTENT%	RELATIVE
P		Sitty of 18, brown, medium to conreg grand mine, medium sange, interbridded with high brown, wer, firm.		\$# 4					
- !:	iji iji			·	1	Ō		44,0	-
10		SAN'S . U. lines, sat rete , soft.		CL.	3	(i)		41.8	
- 15		The tree to great a sette red masser einer, there of organities		- SH -		<u> </u>			
].]	<u>いたこう</u> light brown, medium gratered, entiretion, entire dense.		. 57	•	0.			
		reduction fly dark provincest, roft, interhers to with SAIR LEAD, the stay set, all; trace of organic		,CI.	- 5	O		irī.	
75			-		11	<u>o</u>		25.1	-
30	1			. !					

OC 71-1



io	
45	'71-1101 ' \$
40	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
15	

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ELEVATION



10:

S¢

ALUE ENGINEERING PAYS

PRIVING WEIGHT 18 15, 20 10. PRIVING WEIGHT

G

: 4 922

PENE, FESST RLCWS/TOOT BOOK O BOO OPY FENSITY pet MOSTURE CONTINT IN FREE PREE CONTINT IN FREE

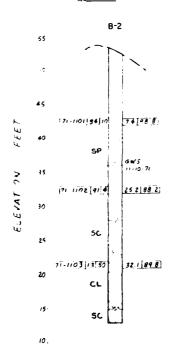
GC71-10

		LEVAT	STATION 58 + 28	W.O.	22-16 4G W	EIGHT	140	TF 3/ 16. 3	4/11 2 1 0 1
WATER	O DEPTH FEET	GRAFHIC SYMBOL	Rotary wish boring, 4 inch diameter and 18" bucket auger OESCRIPTION	GROUP STABCL U.S.C.S	PENE. RESST. BLOWS/FOOT	CORE O	DRY DENSITY per	*	Ι.
4			\$1177 5677; 34; brown sedium to custse grain(), solif, long* Saturate 3 at 5.0'	SH .	*				
*	- 5 -			-		0	50.	23.3	7
	-10-		SAND SP. prayed brown, fire graned, sacurer d, loors to addres dinner.	sp	•	G	-		
	-15-			 	11	0			
	-23-	137711 //	SIEST STAY, CC, gray, we note: interfaction but SIEST 1 (** 505), St., pury, interpted, success to two.	-CL	A	•			_
-	0		S	12.		ত	-	-	
 	10			-		_		_	-

GC71-11

	AG NO		SYATION 64 + 28		NO.	10 W	L DA	140	₹ 16. 3	3/5 2 1 0 1
WATER	O DEPTH FEET	GRAPHIC SYN'BOL	Rotary work boring: 4 inch diameter DESCRIPTION		CACLS	PENE RESIST. BLOWS/FOOT		SITY oct) y	RELATIVE
₹			<u>SILPY SAID: Sr</u> ; brown, redium to currec grained, moist, medium dense; interbedder <u>SILT; Hi; grayish</u> -brown, wet, firm, Saturated at 3.0'		SK 6 HI.	p.e		100	8 17.	
	-10-	自由			- -		0			
-		77	SAND, SP. light brown, fine to coars, grained, saturated, sector dense.	-	. S.P	10	O	-	-	
	-15 -		SILTY CLAY, CL; SILTY SAND; SN; GLAYEY SAND; SC; interbedded, wee, woft.		Cr 2H	17	O		L8.*	
		111	SELTY CLAY, CL. yellowish gray, ver; sedium stiff, sedium stiff, sedium		•	11	0		24.	
-	- 25		,		-	,	3		35.4	_

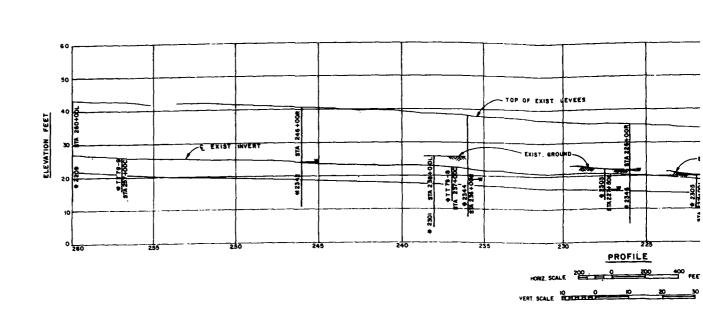
OC71-2

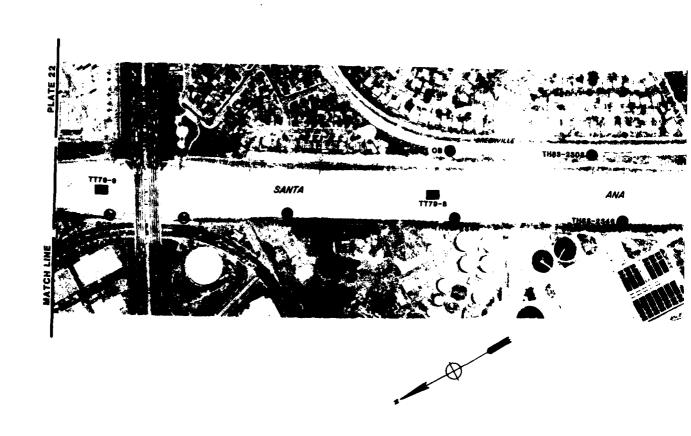


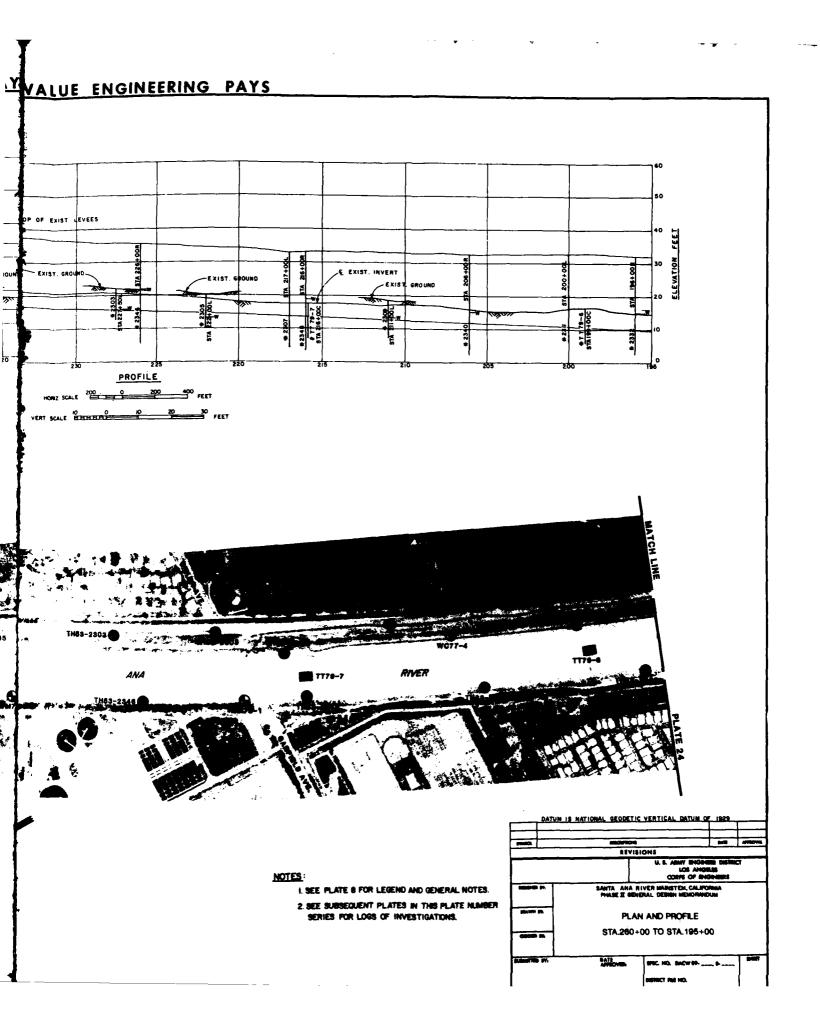
- NOTES:
 1. SEE PLATE 22 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENOS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS
- 5. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE.

REVISIONS U. S. ARMY ENGRAGER DISTRICT LOS ANGELES CORPS OF ENGINEERS SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE IX GENERAL DESIGN MEMORANDUM LOGS OF INVESTIGATION BY OTHERS STA.325+00 TO STA.260+00 SPEC. NO. DACWOP- ___ 6-___

VALUE ENGINEERING







VALUE ENGINEERING

TH83-2342

₹₹	STA 257+00 C						TT79-9 E. 262					
LOG	MC	ц	PI	4	-200	-	BESCRIPTION					
							SILTY SNID: GREY, DRY-					
24	3			89	2							
	34			Q4			SAND: GREY, MOLST-					
9												
-												
	125			96	4							
	LOG	LOG PC	SI 5	STA 25/4 LOG PC LL P1 SM 5	STA 257-00 C LOG	STA 257-00 C LOG MC LL P1 -4 -200 SM 5 89 2 14 99 3 SP	STA 257400 C LOG					

EL- 41±		+00 R	7A 246	2		342	TH83-2
BESCRIPT	-200	4	PÌ	u	MC	UNG	DEPTH
SILTY SAMD: PROMI, MOIST, MET TO I INCH-	 13	94	*		8		
	71	98	•0		15		
	14	89	•		6	94	
SAPE: BROWN, HEDIUM GRAINED-	v	98	10		9		
SAFE: LIGHT TO DARK BROWN-	24	78	4	27	5		
			_				12.0
SMM/SILTY SMM: LIGHT BROWS TO I THOM-							
	4	99	MD.		12	Φ\2 4	
							N 16
CANDY CLAY: RACHEL, MET, COMP.	75	100	17	41	33	a.	9-0
SMIT: SPRY, WET-							
	٩	100			19	26	
							2.5
SAMP/SI!,TY SAMB: PROM. MET,	5	190	₩		27	SP/SM	
			_				5.5
SMIT STUTE FREY, WET, COMES	65	100		35	18	٦	5-5
STUTY SMITH: MINIMA, MET, COME	47	100	रह	55	57	ŞI	7.5
SARG: SARY, MET-	4	1.00			47	20	
							0.0

								TH83-2344
THB3-23	A4			STA 23	5+00 R			EL- 38 #
DEPTH .	LN6	MC.	u	PI	-4	-200	1	DESCRIPTION
	59	11		¥	98	19		SILTY SAND: BROWN, MOIST, FINE GRAINED, NON-CONESTVE-
5.0		9		*	100	24	27	
							20	SANT: 1, IGHT BROWN, MEDIUM GRAINED.
	ዎ	2			39	•		
9.5							29	
		3		*	98	s		SMED/STUTY SMED: 1,1947 RECORD, HEDITUM GRAINED.
	20/3H	3		*	38	5	25	
		н		•	100	8	14	
2.0								
W ,19 <u>.0</u>		20			100	٠	*0	SAND: LIGHT MOON, WET, MEDIUM GRAINED-
	9						8	
		20			100	3	9	
		1,8			99			
.a	a.	¢1	45	19	100	86	7	CLAY: DANK MILEY, CHEMIC SPELL, CONESTON-
1.5	99	8			100			SARD: LIGHT OREY, FIRE TO HEDIUM GRAINED.
<u></u>						<u> </u>		Cian act, the rolled division

INVE	RT					1	T79	9-8
1179-8			٠,	14 237	+00 €			 FL. γ
DEPTH	Luc.	PC	u	P۱	4	-200	*	PESCRI
	9P/9#	3		¥	90	8		SAMIL/STLEY SAMTH: GREY, HOT
4.0	 -				10n			SMID: SREY, MOIST.
	Sp.							
		16			95	ı		
0-0	·							

ALUE ENGINEERING PAYS

TH83-2342

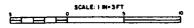
				-	
	ŞT	A 246	•00 R	_	 £l. 41t
	u	PĮ	4	-200	DESCRIPTION
		ΗP	ng.	13	SILTY SAMD: ROOM, NOIST, MEDIUM TO FINE GRAINED GRAVEL TO I INCH.
		40	78	ગ	
		Ψ	39	14	
		•	98	V	SAFE: BROWN, PEDIUM GRAINED
	77	•	98	 29 -	SME: LIGHT TO DANK BADON-
		10	94		SMPUSILTY SMITH: LIGHT BROWN, MEDIUM GRAINED, FBM GRAVEL TO 1 INCH-
	41	17	100	75	SMETY (LAY: ROOM, MEY, COMPSTME-
_			100	ù	SMR): Spey, wet.
•		Ψ	190	ς ,	SAMINTI, TY SAND: SHOWN, WET, MEDIUM GPAINED-
Ì.	- 35	,	190	- 55	CANNY SILT: FREY, HET, COMESTIVE
-	55	75	100	47	STUTY SMIT: MOTION, MET, CONESIVE.
			יעון	1	CΦED: GREY, MET-
_					

EXIS		GR() A 238	-00 L		THE	34 - 2301 EL- 26±
DEPTH	LOG	MC	ш	PI	-4	-200	N	DESCRIPTION
	SM	,		ЖP	37	3		SILTY SAND: BROWN, MOIST, LOOSE, FINE GRAINED SAND-
3.0							11	
	SP				99	4		SANO: BROWN, MOIST, LOOSE, FINE GRAINED SAND-
6-0							3	
	rL.	34		K2	100	62		SANDY SILT: DARK BROWN, MOIST TO WET, LOOSE, FINE GRAINED SAND, SOME CONESION.
9-0							5	
		33		ЖP	100	47		SILTY SAND: DARK GREY, NET, LOOSE, FINE GRAINED SAND, SOME COMESION.
	S#I	_					3	
				Ψ	99	27		SAME: BLACK, ORGANICS.
15-0								
	a		41	24	100	75		SANDY CLAY: DARK GREY, MOIST TO MET, STIFF TO SOFT, SOME ORGANICS.
18-0								
	a		51	25	100	75		SAMBY CLAY: 1.10HT GREEN, MOIST TO WET, STIFF TO SOFT, SOME GRAVEL.
21.3								

TT79-8

	***	A 237	09 C			ናር. ንን ኔ	
-	I,L	ÞΊ	4	-270	•	PESCRIPTION	
		*	10	3		SAME/SILTY SAME: GREY, MOIST-	
			:9°	,		SARD: SREY, MDIST:	
			r	:			

HB3-23				A 227-				DESCRIPTION
EPTH	L06	'n.	u.	PI	-4	-200	4	JESCRIPTION
	523	13		₽	100	26		SILTY SAND: SROWN, MOIST-
3.0		21		КP	190	24	8	SAVE: GREY, MOIST, CAVENG-
4.5	'n	3)	59	15	100	88		SILT: Moist, comesive.
		30		Мo	170	10	ó	SAND TILTY STATE THEY, MOIST, FINE GRAINED.
N 6 5	SP/98	25		¥Ρ	100	۹		



NOTES

- I SEE PLATE 23 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2. SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

SYMBOL	MACHITICH		BATE	APPROVA
- -	REVI	SIONS		
		U. S. ARMY ENGINE LOS ANGE CORPS OF ENG		đ
DESIGNED ST.	SANTA ANA PHASE II Œ	RIVER MARKSTEM, CALIFO NERAL DESIGN MEMORAND	PONIA NUM	
SEAWN ST.	LOGS	OF INVESTIGATIONS	3	
	CORP	S OF ENGINEERS		
0000 PL	STA.257-	+00 TO STA.227+50)	
NAMETYED BY.	DATE	SFEC. NO. BACWOP.		9667
		ORDECT FLE NO.		i

VALUE ENGINEERING

TH 83 2346

TH 83-2	346		ST	A 220	5+00 R			£. 36t
DEPTH	1.06	MC	u.	Pī	4	-200	-	Description
	98	8		*	99	ע		SILTY SAND: Brown, MOIST, MON COMESTIVE.
4-0				-	100	7	. 34	
-	S#/S#	6		1P	99	12	10	SAND/SILTY SAND: GREY, MOIST, FINE TO MEDIUM GRAIMED-
7.0	SH	6		₽	100	13	. 22	SILTY SAND: BROWN, MOIST, FINE TO MEDIUM GRAINED.
0.0	2M/2M	9		*	93	12	u	SAMP/SILTY SAMP: BROWN, MOIST, FINE TO MEDIUM GRAINED GRAVEL TO 1 INCH-
3.0 V 15.0		7		19	99	11	10	SANTA/STLTY SANTA: GREY, WET, MEDIUM GRAINED,
	•	26		IP	100	6		
		29		₩	100	5	12	
	SP/SH	_					9	
		24		₩	100	5	372	
				IP	100	5	17	
1-0							15	

TH 83 2346

TH83-2	348			TA 21	6 +00 R	EL. 332					
DEPTH	L06	r(C	u	PĮ	4	-200		PESCRIPTION			
								SILTY SAND: LIGHT BROWN, FINE GRAINED, NON-CONESIVE-			
	94	9		#P	99	79	61				
7.0		र		- PF	197	15	21				
		6		MP	99	12	12	SANTASTETY SANTA: LIGHT BROWN, FIRE BRAINED, HOW-COMESTVE			
	92/94	-			94	,					
3.5					- XB		5				
14.	31		_	_P)(1)	_ A .		SILLY SUP. BOOK, CONSINE.			
7.p	39/59	22		۳	99	9	8	SAMO/SILTY SAMO: LIGHT BROWN, MEDIUM GRAINED, NON-CONESINE.			
<u>/</u>		42	53	9	100	66	5	SANDY SILT: Brown, coverive.			
La_		33	33	,	190	61	n				
5.a	Q.	44	37	14	100	70	**	SARRY CLAY: BROWN-PRRY, DRAWISC, CONESTVE-			
	7	u	3	-	100	1		SIN A THE ROOM PLANTS.			
1	7/1	1	_	1		7		AND THE PARTY OF THE PARTY.			
5.0	a	77	×	11	100	-6		SMAN CLAY: MARY, COMESTVE.			
	97	28		•	100	13	16	STLTY SAITH: BROWN, PROTUR WATER			
.0											

TH 83 2305

TH83-23	TH83-2305		2.	TA 222	+00 L			EL- 20±
DEPTH	L06	N,	tĻ	Pl	-4	-200	H	DESCRIPTION
2.5	54	В		180	96	34		SILTY SAND: BROWN, HOIST, FINE GR
4.0	cī	28	41	21	130	71	51	SANDY CLAY: BROWN, DENSE, COMESTA
		15		#	100	31	7	SILTY SAND: GREY, WET, FINE GRAIN
W 7 5	SM							
		23		ię	97	21	4	
10-0 10-5	2027	3		P	100			SHE SILIY SAND: GREY, MET, CAVIS

7-14-7			5	14 21 5	+ 0 0 (EL- 18±
DEPTH	L06	40	U.	PĮ	4	-200	N	DESCRIPTION
	94	,		ø	9 1	13		SILTY SAND: GREY, MOIST, FISH CI
4.0	 SP	n			100	2		SAND: APEY, MOIST-
	Ĩ	16			99	2		
10-0								

LUE ENGINEERING PAYS

TH 83 2305

_	21	- 4	-24	*	DESCRIPTION
-	¥	*	34		SILTY SAND: SHOWN, MOIST, FINE GRAINED, SOME GRAVEL
-	21	.)	71	71	SAVEY CLAY: BROWN, DENSE, COMESTVE.
_	N/P	, y:	п		SILTS SANTE GREY, WET, FINE GRAIMED-
ţ	۳	- -	21	4	
	100	100			AND A ILLY SACE: GREY, MET, CAVISA.

TT 79-7

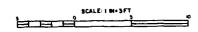
ŞĪ	A 215	a) c		EL : 18#								
.L	Pj	-9	-200	*	DESCRIPTION							
					STUTY SAME: GMEY, MOEST, MEN COMMILES TO 12-INCH-							
	Ψ	11	18									
		, yn	2		SAMO. GREY, MOLST-							
		19	2									

TH 83-2307

183-23	107		\$1	A 217	•00 L			EL- 18±
EPTH	L06	MC	u.	PĮ	4	-200	H	DESCRIPTION
	SH	,		MP	94	19		SILTY SMD: Brown, MOIST, MON-CONESTVE, MEDIUM TO FINE GRALHED-
	J1	7		NP.	98	21		
1.0 5.0	S9/SF	5		₩	92	12		SMID/STLTY SMID: SME, GRAVEL TO 2 INDES.
		9	19	3	100	29	16	SILTY SMIT: PROM, MOIST, SOME COMESTON, FINE GRAINED.
		8		IP.	100	42		
	SPI	_					24	
		10		MP	100	14		
		6		NP	95	20	21	
3.0 9.0	SC	16	ठ	8	100	41		CLAYEY SAITS: "MAKE BROWN, COHESTIVE.
		7		18P	97	15		SILTY SAND: BROWN, MOIST, HON-COMESIVE, GRAVEL TO 3 INCHES-
		14	20	3	100	33		
	SPI	13		₽	100	34	16	SAME: GREY, MOIST, ORGANIC SMELL-
1-0		15		NP.	100	71	22.	
2.0	979	22		1	100		21.	SMID/SILTY SMID: BROWN-
23.0	591	23	32)	2	100	49		SILTY SAID: GREY, NET-
9.0	. JP1	33		P	100	46	5	Statt Smirt, Smart mast
-W-	sc	39	41	ע	100	46	, ,	CLAYEY SAND: GREY, MET, COMESTVE-
27.0			_				5	
	1	41		16P	100	50		SANDY CLAY: SAME AS ABOVE-
9.0							. 5	

NOTES:

- I SEE PLATE FOR LOCATION OF TEST HOLES AND TEST TRENCHES.
- 2. SEE PLATE FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3. SEE TABLE FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.



ETHIRCK .	1800H71014		DVA	AFFROVAL						
	REVIS									
		U. S. AMY BYGH LOS ANGE CORPS OF BY	46	.						
00000 Fr.	SANTA ANA R	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM								
SIGNAM SIN	LOGS OF INVESTIGATIONS CORPS OF ENGINEERS									
Opp. CHI	STA.226+00 TO STA.216+00									
BURNITHED BY:	DATE	SMC. NO. DACWOR		500						
l				1						

VALUE ENGINEERING F

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EXIST 1183-23		GR	INUC S	_	+00 L		_	EL. 19±
DEPTH	L06	NC.	u	PI	-4	-200	N	DESCRIPTION
	SM	15		NP	97	36		SILTY SAND: Brown, MOIST, MON-COMESTVE.
							30	
5.0		14		165	100	29		
6.5	n.	34	42	15	190	76	В	SAMELY STELT: GREY, MOIST, COHESIVE-
8.0								
	SM	30		MP	100	16	2	SILTY SAND: GREY, WET, MON-COMESIVE.
1:0	u	31	亚	19	190	93	3	SAKIY (LAY: GREY-

TH83-2332

33-233	2		5	TA 19	6+00 R		€L • 37 #					
тн	106	ж	u	ÞĮ	-4	-200	H	DESCRIPTION				
		9		W	99	30		STLTY SAND: BROWN, MOIST, NON-CONESIVE-				
	SM	5		NP.	100	22	31					
-				TP	100	Z						
								SILT: DANK BROWN, FDIST, COMPSIVE.				
L	54	6		₩	99	16	15	STLTY SAME: BROWN, MOIST, MON-COMESTYE-				
		3		₩	99	6		SAND/SILTY SAND; LIGHT BROWN, HON-COMESTIVE.				
							10					
5	P/SM	4		MP	100	8						
		_					9					
		4		#	93	8		SAFE: GREY-				
							8					
	SPI	26			99	26	•	SILTY SAND: BROWN, WET, LITTLE COMESTON-				
.0	1			P	100	- 55		SMIT SILT: MON. NET. CONTRIVE.				
		24		•	190	6	8	SAMB/STLTY SAMD: GMEY, MON-CONESTVE-				
2	P/S#	24						SME: Brownery, non-onestive.				
		4		•	199	,	9					
	T.	40		P	100	55		SMOY STITE MORE, CONSIDER				
	W	50	53	23	100	71		SHOY YILT: SHEY, CONESTVE.				
	OI.	10	51	74	190	69 -		SMAN CLAY: BROWN, COVESTIVE.				
		53			100	<u>p</u>		SAMPY SILT: FINEY, MON-CONESTIVE.				
	A.	40		P	100	60	6	ALTERNATION STATES AND STATES				
		r	33		100	80						

TH83-2340

						1803-2340				
TH83-2340			TA 20	15+00 R			EL · 342			
DEPTH LOS	MC	ш	PI	4	-200	*	DESCRIPTION			
							STLTY SAID: Brown, MOIST, HON-COHEST			
	14		Ψ	99	?4	44				
	ıΤ		P	100	19	25				
34	39		#	100	20		SAFE: LIGHT BROWN, LAVERED WITH DARKS			
	11		WP	99	19	8				
2.0 2.5 9 79	7		*	100	44	٠	CHRET W CHA			
3.0	4			100	<u>\$0</u>	8	SULTY SAND: LIGHT MICHAEL, FINE SE SILTY SAND: LIGHT MICHAEL.			
59/59 5:0.	27		φ	100	10	9	SMED/STLTY SMED: LIGHT PRODUCT MEDIUM 1			
	23		4P	100	36		STLTY SAND: DANK BROWN-			
<u>19-0</u> 94	34		₩	100	27		SME: Retion, NON-COMESTVE-			
.5	79	23	5	100	47					
M	ш	n	53	190	58		SAPPY SILT: PROWN, COMESTVE-			
<u>.5</u> 54	25		ИP	100	23		SILTY SAND: GREY, FINE GRAINED, ORGAN			
59/5H		_	H P	109	9		SAND/FILTY SAND; GREY, FINE TO MEDIUM CONESTME.			

1179-6	R (57	TA 199	+30 C			FL- 164
DEPTH	1,06	۳K	1,1	Pį	-4	-200	M	DESCRIPTION
		1:		Мo	98	34		SILTY SAMT: GREY, MOTST.
	S#	_						
		16		ИP	100	41		SAFE: RATHER, MOIST.
7.0								
	3 P/5 4	20		Ψ	100	10		SAMPLYSTETY SAMPLE BROWN, WET, GROUNDING
10.0								

LUE ENGINEERING PAYS

TH83-2340

					70
STA	206	+00 R			EL- 34t
	PI	-4	-200	N	DESCRIPTION
					SILTY SAND: BROWN, MOIST, MON-COMESIVE-
	₩	99	?9	44	
_	₽	100		25	
;	100	130	20		SME: LIGHT BROWN, LAVERED WITH DANKER SILTY SAND-
•	₩	99	19	3	
_	NP NP	100	44	*	SMD/SILTY SMD: LIGHT ROOM, FIRE GRAINED-
	Þ	130	¥C.		STLTY SAID: LIGHT MODEL:
•	₩	130	10	g	SMID/CILITY SAND: LIGHT WHOMA, MEDIUM TO FINE GRAINED SAND
	*	100	16		CILTY SAND: TANK BROWN
	•	100	27		SAME: MACHINI, NON-COMESTIVE-
-	5	100	4.7		
je J	58	190	58		SAMPLY STLT: "ROWN, COMESTIVE-
	₽	100	23		S', TY SAND: GREY, FINE GRAINED, ORGANIC SMELL, CONESTVE-
	IP	lm.	,		SMB/CILTY SMM: AREY, FINE TO METIUM GRAIMED, NON-CONECIVE.

TT79-6

STA 19	9+00 C			FL. 162
יָפ	-4	-790	Ħ	DESCRIPTION
яф	Ħ	74		SILTY SAMT: GREY, MOIST-
NP		મ		SAT: BROWN, MOIST-
u p	18	:		TANN/STETY SAMITY BROWN, WET, GATUMBHATEN ENCOUNTERED-

TH83-2311

								193-2311
TM83-23	11		\$1	A 200	+00 L			FL. 33±
DEPTH	L06	MC	щ	PI	4	-200	Ħ	DESCRIPTION
		11	24	4	100	45		SILTY SAND: BROWN, MOIST, SOME GRAVEL TO 3 INCHES-
		8		W.	100	39	R	
		8		₩P	96	14	61	SAME: LIGHT BROWN, MOIST, MEDIUM TO FINE GRAINED, GRAVES TO $1\!-\!1/2$ INCHES-
	SPT	9		WP	99	37	22	SAME: BROWN, HOIST. GRAVEL TO 3 INCHES-
		9		HP	100	31	15	
		12		HР	100	31	D	
15.0							24	
17-0	M.	1,2		₩°	100	51		SAMPY SILT: DANK BROWN, MOIST, SOME COMESSION, SOME GRAM TO 3 INCHES-
1/ ·V		_5_			100	2	14	SILTY SAMD: LIGHT BROWN, MOIST, FINE GRAINED
		10		WP	100	35		SICIL OND: Clark Manny Portary Fine Statement
	SM	7		MP.	96	17		
		16	24	3	100	31		SAME: LIGHT BROWN, MOIST, CONESIVE-
22.5								
¥ 24.0		34	34	,	100	75	5	SAMBY SILT: GREY, WET, SOFT, COHESIVE, SOME ROOTS.
	Æ	35	48	20	100	80		
27-0							5	

NOTES:

- I. SEE PLATE 23 FOR LOCATION OF TEST HOLES AND TEST TRENCHES.
- 2. SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4. ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

\$CALE: (N-3FT 5 0

SYMMOL	WEGIFTON CO.		BAR	APPROV.				
	REVI	SIONS						
		U.S. ARMY ENGINEE LOS ANGEL CORPS OF ENGI	15	3				
Planyello 97.	Santa ana Phase II ge	RIVER MAINSTEM, CALIFOR ERAL DESIGN MEMORANDI	NIA Mi					
STATUTE OF	LOGS C	F INVESTIGATIONS						
	CORPS OF ENGINEERS							
0000 FM								
	STA.211	+00 TO STA.196+0	0					
SUBMITTED BY:	DATE	SPEC. NO. DACWOR.		997				

WC77-4

	ESTATE DE	BLOWL/ PROT		DESCRIPTION	STREETH, IL	CONTEST, %	Dev Deserv	
	1	,		Based ELVATOR: Medium dense, to dense, moist, brown, SILTY SAND (80) With trace of SILTY CLAY				196
•	2	,		Slight odor, bluish gray				
•1	,			Medium dense to dance, noist, light brown madium- grained SAND (SP) with some GRAVEL				CI.
• - -	•			Stiff, moint, brown SILTY CLAY (CL)		6	87	
•-	5			Bluish gray with organic untertal Medium descept, noise, light brown medium-grained, SARDY SILT (ME) with roots to 1"	3.00	9	75	
•	•	,	₽	Mot, brown SILTT SAND (SN)		28	93	

WM73-1

m		. 0	MILL	LOG 5 26 May 1973 WATER DEPTH DATE ME. ROB Coot. Filght Auger MCLE DIAME MMER 140 1bs. FALLING 30" SAMPLES 2" MOST	ASUR1	0 <u>2</u>	4 Hoy	
BEPTH, PT.	BAMPLES	BLOWS/POOT	CROUND	DESCRIPTION RUPPAGE ELEVATION:	UNC. COMP STREMSTN, No	MOISTURE CONTENT, %	Der DENBITY	OTHER TERTS
	1	33		Dense, damp, brown fine to coarse-grained SAND (SP) with trace of STLI		10	100	
•	2 (26		Fine to medium-grained				M.
1.0	,	16						ž.,
15		20		Fins to coarse-grained, wet, coving		٨	96	154
20		30	Ţ					
2.0				With trace of CLAY				
_	1 -1	1		Settom o" lag at 26 ft,	ليا	الل		

GC 71-1

Т		TION/*				EIGHT				
WATER	GRAPHIC SYMBOL	Active wish boring, a inches diameter. DESCRIPTION	GROUP SYMBOL	FENE RESIST	BLOWS/FCOT	0 3 97	, is	DE NO.	CONTENT %	RELATIVE
Τ.		SILTY C'AY, CL. dark brown, Notice,	F	T			Г	Ī		ī
Ė		1001	۴	L						
V	, / <i>//</i>	<u>\$RED: SP</u> light brown to gray, coarse to mollum crusined, saturated, loose to mediat dense.	-	t	13	0	89.6	Į,	28.1	Ī
F]		F.,							
- -	°† ',,,		-	†	Š	<u></u>	100	,	20.5	67
_		Sill Clay, OL; black to gray, wet, actt, sure organic interhedded with strike of MNO, St. saturated loose.	ŀ							
-	ווו				101	ত	46	1	25.0	•
	NA NA	SILTY FIRE SAND, SH, black, saturated, loose.	F	-	-		-	Ŧ		
F	=		<u> </u>	,	-	0	83.	-	36.0	80
- [25	* Driving weight under water.	_	-	-		-	-		ļ
F			F							

GC 71-2

BORING No	- 1		STATION	7 - 39 _		wo_	22-16	<u>*</u> _ D+	ALL DA	ATE	3/7
SURFACE L	LEVAT	102				DRIVIA			<u>500</u>	Ub.	0 (
WATER OCEPTH FEET	GRAPHIC SYMBOL	Rotary was	DĘSCRIP		esta fair	OPOUP SYNAS.L U.S.C.S.	PENE RESIST	CORE	DRY DENSITY acf	MOISTURE CONTENT %	RELATIVE
	重宝语	21.17.7.1.3	<u>5380, 54</u>	. Liber, re	antigra e esak	-5×					
Δ,							,	0	89.2	24.	76
-	777. 777)	071.4	b; t , black or wet, loos	1 -10 24	1.21.5	CL SH	6*	O	84.	34 , (
-15-	/// 							0	83.7	, זג.	72
zo-		SANT SE.	gray, fâne	græsn d, '	vr1 .	58	9*	0	8A.8	29.1	76
-25-		STAX A.S.	black, sa	torated, "		OH	A	ତ	68.5	13.1	39
		• Driving	, weight us	nder water		-					

LOG OF BORING I

UMC. COMP STRENGTH, NO	C MOSTURE	THE DEVENTY	OTHER TESTS
	10	100	
			AA P
			N,
	٠	96	PA.
		4	4 96

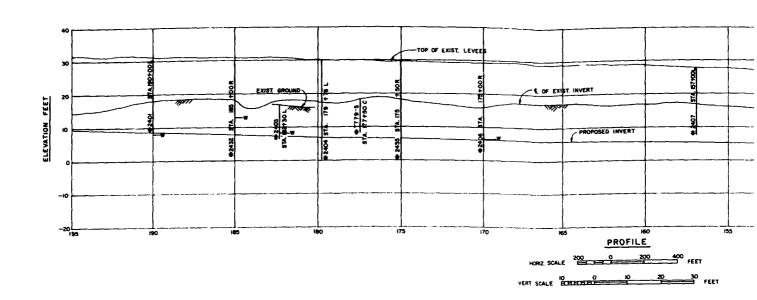
	DP V.A	is we	*5.4*		b - 25	15
	USCS	26.5 A \$ 15.51 5	ુદ 19.18	C. NSITY per	PLASTONE CONTENT%	FLATINE
1154			Ġ			
				,	- 3	7:
		*	3	84	14.8	•
,		•	6	68 5		1.0
		<u> </u>	<u> </u>			

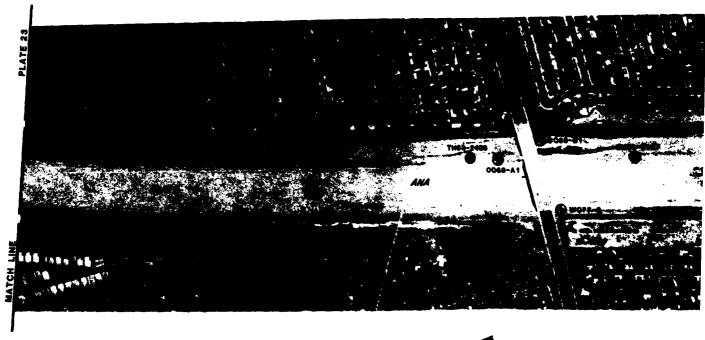
WO THE THE DATE VILL

NOTES:

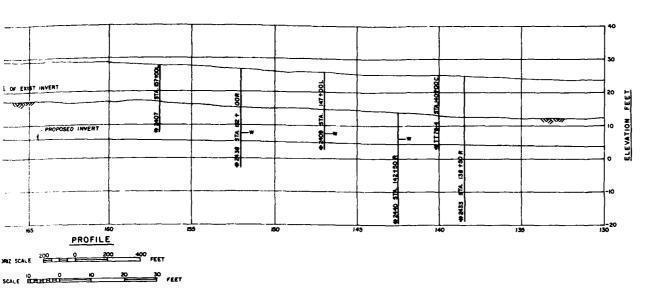
- I. SEE PLATE 23 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE.

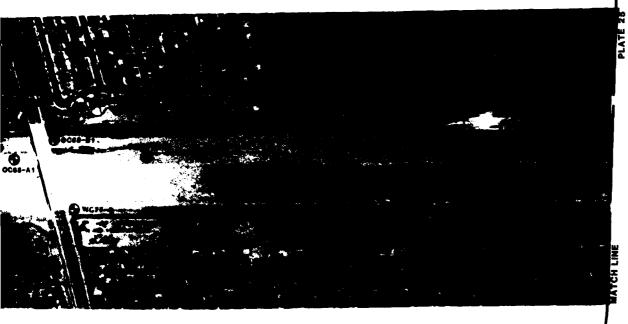
STHECK	tescerno-s	DAR	APPROVAL
	REVIS	IONS	
		U. S. ARMY ENGINEER DISTRIC LOS ANGELES CORPS OF ENGINEERS	ŧ
1000040 81.		RIVER MAINSTEM, CALIFORNIA ERAL DESIGN MEMORANDUM	
DEAWN DV.	LOGS	OF INVESTIGATION	
<u> </u>		BY OTHERS	
CHECKIN ST.	STA.260+	-00 TO STA. 195+00	
SUBMITTED SY.	APPROVED.	SFSC. NO. DACW 09 B	SHIET
1		I	











NOTES

I. SEE PLATE & FOR LEGEND AND GENERAL NOTES.

2. SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

DATUR	IS MATIONAL SECCETIC	VERTICAL DATUM OF I	929	
974-00A	*******		2462	Michigan
	REVI	SIONS		
		U. S. ABMY SHIGH LOS AND CORPS OF SH		
Mangaran (fil		RIVER MAINSTEM CALIF IGRAL DESIGN MEMORAN		
SECOND SE	PLAI	N AND PROFILE		
ONE IN	STA.195+	-00 TO STA.130+0	0	
automb m	DATE APPENDE	SPEC. HG. SHCW 69		9,444
		DISTRICT FILE HO.		}

TH83-2401

NB3-24	01		2	TA 190	+0 0 L			EL. 31±				
EPTH	L06	MC	ш	Pl	4	-200	N	DESCRIPTION				
		9		10	99	27		SILTY SAND: BROWN, MOIST, NON-COHESTVE. FINE GRAINED-				
		7		- IP	99	30	46	SAME: "CCASIONAL CORRLE TO 4 INCHES-				
	SM	8		NP.	100	27	36					
1.5		8		1P	100	39	22					
2.0	N.	15		¥P	99	55	18	SANDY SILT: DANK BROWN, MOIST, FINE GRAINED, NO GRANEL				
		5		ЖP	97	?0	10	SILTY SAND: LIGHT NAPHN, MOIST, FINE GRAINED, HON- CORESIVE, NO GRAMEL.				
	91	6		40	100	39	26	SAME: POCASIONAL GRAVEL TO 1-1/2 INDIES.				
		10			100	24	74					
. <u></u>	य	70	77	-5	100	12	q	CLAVEY SAPO: GREY, MOIST.				
23.0	M.	74	ম	3	100	67		SAMY SILT: GREY, HET, COMESIVE, FINE GRAINED. SAME: GREY, MET, COMESIVE, FINE GRAINED.				
-0	α	30	29	,	100	55	5	SAMDY CLAY: SREY, WET, FINE GRAINED-				
. <u>o</u>	1	35	29	4	100	57		CANTY SILT: SHEY, HET, COMESTME. SAVING AT 29 FT.				

TH83-2404

483-2404			4	STA 179	9+78 L			£(- 30t		
EPTH	L06	TC.	u	PĮ	- 4	-200	4	DESCRIPTION		
		10		¥	99	16	31	SILTY SAMD: BROWN, MDIST, LOOSE, MEDIUM GRAINED, OCCASIONAL COMBLES TO & INCHES:		
		3		φ	91	'1	,,	SAFE: GRAVEL TO 3 INDIES-		
	581	5		₩	100	19	23	SAME: LIGHT BROWN, MOIST, FINE GRAINED, NO BRANEL.		
		П			99	TO TO		SAFE: BROWN, LAYERS OF CONESIVE SANDY STUT-		
1.5		9		P	136	75	28	SAME: "POCCASIONAL GRAVEL TO 3/4 INCHES, MON-CONESIVE-		
! ;	SW/SM	4		P	95	12	34	SAND/SILTY SAND: BROWN, MOTSY, MON-CONESTVE, MEDIUM TO FINE GRAINED, SOME COMMLES TO 5 IMPRES.		
		3		P	luo	28	35	SILTY SAMT: "ROOM, MOIST, MON-COMESIVE, FINE MRAINED, SOME MOOD FRAMENTS, NO GRAVEL.		
.3	SP	,		*	99	75	29			
	34/54	5		₩	31	8		SAMPLYSILTY SAMP: 1.10-IT MICHIN, MOIST TO WET, MEDIUM TO		
1	OI	Đ.	59	79	100	- 34	14	SAUT CAN'S SEEN NO REST STAIRS, NET, FIRE GRAINED		
.د	SM.	12			97	19		SILTY SAND: BROWN, MET, MEDIUM GRATMED, LAYERS OF LIGHTER, SALT.		
								SAMETY SILT: GREY, HET, SOFT, FINE WAINED, COHESIVE-		
	•	7	79	,	100	73	9			
<u>.a</u>										
	CH*	50	91	25	lon	e?		SAMPY CLAY: GREY, NET, SOFT, FINE MAXINED, COMESTVE-		
1										

TH83-2432

THB3-20	THB3-2432		21	A 189	+90 R			€ 31°		
DEPTH	L06	MC	u	Pļ	-4	-200	N	DESCRIPTION		
_	_			м	99	14		SILTY SAND: NOON, NEDIUM GRAINED-		
				-		_				
	SM			—			23			
		9		₩	100	18				
6.0							23			
								SAND/SILTY SAND: LIGHT BROWN, MEDIUM GRAINES		
		4		ИP	100	g				
		_					8			
		2		ıφ	100	6		SAFE: FIREY, MOIST-		
	SP/SM	_					6	SAFE: LIGHT BROWN, MEDIUM GRAINED.		
		r		Ψ	100	9				
							6			
				ж	100	9		SAME: FREY, MOIST, MEDIUM GRAINED.		
7.5.				*	100	,				
18.0							5	SAMOY SILT: BROWN, MOIST-		
	SM			NP	100	40				
	3ri			10-	100	43	9			
2.5								SANDY SILT: BROWN, MOIST-		
	M.	13		帕	100	55	9	gator ster, many serat-		
5.0 5.5	a		38	14	100	55		SANDY CLAY: GREY, MET.		
				MP	100	56	۵	SAMBY SILT: GREY, MET-		
	п.	_					4			
	-			Ψp	100	65				
0.0					-		5			

INVE	२ Т						<u>T</u>	<u>1779-5</u>				
T179-5			5	TA (1)	+50 C			₹L - 18¢				
DEPTH	L76	P(U.	Ρ;	-4	-?00	4	PESCRIPTION				
	SN/SM NP 29 11			11		PRINTELLY SAND/STUTY GRAVEULY SAND. GREY, MOSS VESSETATION.						
4.0	.1											
			46		SILTY SMIT: SREY, MOIST-							
7.0												
	۹.			¥:	190	59		SAMOY SILT: SREY, MOIST, SOME COMESION.				
10.0												

TH83-2432

	+0C P			€- N±
14	-4	-200	*	DESCRIPTION
ЩP	99]4		SILTY SAND: BROWN, MEDIUM GRAINED-
			23	
*	1.00	19		
			23	
*		٩		SAND/SILTY SAND: LIGHT BROWN, MEDIUM GRAIMED-
			8	
¥	15	6		SAME: GREY, MOIST-
			5	
¥		,		SAME: LIGHT BROWN, MEDIUM GRAINED-
-			5	SAME: AREY, MOIST, MEDIUM GRAINED.
₩				
			•	SANTY SILT: BROWN, MOIST-
۴	ÍΚ	-,	,	
¥.		-4	1	SAMPY SILT. BROWN, MOIST-
13	-110			SMENY CLAY: GREY, MET-
*			è	SAMTY SILT: GREY, MET-
40				
			5	

TT79-5

****	Ft. 18±
21	N DESCRIPTION
≠ 1	CREATION SAND/SHIP GRAWFULY SAND. GREY, MOIST, VEGETATION.
₩ 1 -	T. Truett Ger, April
* ;	**************************************
♥ 19	SMPY Of The GMEY, Motist, Some COMESTON-

EXISTING GROUND

TH63-2403

N83-2403		STA 182+30 L					FL- 145				
PTH	L06	MC	ίι	PĮ	-4	-200	*	DESCRIPTION			
	S#	14		NP.	99	16		SILTY SAND: BROWN, MOIST, MON-COMESIVE-			
.D _		10		W	100	77	8				
5.5	જ /ଫା	9		жP	100	12	6	SAND/SILTY SAND: PROM, MOIST, NON-CONESIVE-			
-0	<u>a</u>	35	38	15	100	55		SAMINY IT AY: THANK GREY, MET, COMESTVE			
0.0	SP/8H	74		₩0	101	9	11	SAND/SILTY SAND: BROWN, WET, NON-CONESIVE, STOPPED DRILLING DUE TO CAVING.			

NOTES:

- I SEE PLATE 24 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



SYMBOL	DESCRIPTIONS		DATE	APPROVA
	REVIS	IONS		
		U. S. ARMY ENGINE LOS ANGE CORPS OF ENG	LES	
CERCHED EV.	SANTA ANA PHASE II GEN	RIVER MAINSTEM, CALIFO ERAL DESIGN MEMORANO	RNIA	
DRAWN BY		F INVESTIGATIONS S OF ENGINEERS	3	
OROSO Ph	30	-00 TO STA.177+	80	
ì	51A.19U1	-00 10 STA.177+	30	
SUBMITTED BY:	DATE	SPEC, NO. DACWOR-		31400

TH83-2435

							-	
1183-2435			\$	TA 17	5+00 R			EL. 30t
EPTH	L06	MC	u	PI	4	-200	1	DESCRIPTION
		8		IP	100	29		SILTY SAND- BROWN, NOIST, MEDIUM GRAINED-
		_					. 41	
				NP	100	25		
				- NP	99	13	7	SAME: LIBHT BROWN, DRY, FINE GRAINED-
	291			MP	100	34	3	
				MP	100	23		SAFE: GREY-BROWN, MOTST-
		_						
				*	100	19	5	
<u>} </u>	3/51			P	100			SANDASILTY SAND: SALEY, MOIST, MEDIUM GRAINED.
.0	SM			MP.	100	32	5	SILTY SAND: DANK GREY, MOIST, FINE GRAINED-
.0	Æ			1	100	71		SAMUY SILT: BROWN, MOIST, FINE GRAINED.
.0	4			N.	100	31		STETY SANTE BROWN, MOTST-
5	4		_	-	100	3		SMOV STUT: Becom, HOIST. SILTY SAND: BECOM, HOIST.
	CH		52	28	100	58		SANTY CLAY: BANK BREY, CONESIVE.
g				-	100	_		SILTY SAND: 58EY, FIRE TO REDUCE GRAINED.
0	3			-	-199	7		SIL 1: Brose.
0	CH CH		51	77	100	56-		SMOT CLAY: DANK GREY.
1	N.			-	100	90	15	SMRY SILT: FREY.
<u> </u>	57			10	100		•-	
5	517SC		76	6	100	- 13 13		STLY SAID ALL SAID; GREY.
			34	,	100	79	17	SAFTY CILT: DANK GREY-
					100	71		

TH83-2406

TH83-2	2406			STA 1/	0-00 L			EL- 29t
DEPTH	L06	PC	u	PI	-4	-200		DESCRIPTION
		6		φ	99	29		SILTY SAMD: BROWN, MOIST, OCCAS 3 INCHES-
		7		•	100	22		SAVE: CLEAN SAND, NO GRAVEL.
		9		*	99	24	n	
	SM	13		WP.	97	26	15	
		ia		*	100	39	19	SME: FINE GRAINED SMID, LENSES
		3		Ψ	95	23		SAFE: REDIUM GRAINED, CHUNK OF I CONESTVE-
		19		*	99	19	8	SAPE: LIGHT BACHN, FINE GRAINED
.0		9		φ	100	77		SAFE: BROWN, MOIST-
-0_	SP/SH	20		*	100	11	9	SARB/SILTY SAMP: LIGHT BROWN, FE
<u>.v</u>	CH	33	59	52	100	67		SANDY CLAY: BROWN, MOIST, COVEST
	ZIVZC	25	74	-5	100	27	14	CLAYEY SAND: BROWN, MOIST, COMES
0 22 5 0	51	27		*	100	70		STLTY SAID: NET.
	a	35	43	34	100	87	6	CLAY: GREY, PLASTIC, SOFT-
.00	_	37	29	,	100	71	8	SAMELY CLAY: SHEY, FINE GRAINED S.

							Ţ	183-2438				
THB3-2	438			STA 1	52+00 P		EL - ?7t					
DEPTH	L06	MC	u.	P	1 4	-200	,	PESCRIPTION				
		_		*	99	25		SILTY SAND: DANK BROWN.				
				×	99	35	. 12					
				15	39	37						
	5 **	_		W.		40	. 13	SAFE: LIGHT BROWN, MOIST, FINE GRAINES				
					98			SAME. A SAME THE PROPERTY OF THE PARTY OF TH				
				•	100	35	. 6	SME: LIGHT BROWN TO GREY, LYDSE, DRY.				
		2		100	100	74	. •					
2.0		·		•	100	4	_					
	7P/9#				ton		9	SAND/SILTY SAND: GREY, DRY, FINE TO MEDIUM GRAINED.				
5:0		•		•	(U)	11		The state of the s				
1	37				100	15	9	STUTY SMID: GREY, HOLST-				
1				-	101	4		SILT CON MONEY				
.0		76	प्र	5	100	51	6	SHOT SILT: DAW MOUNT, HDEST.				
19.5								SANDY CLAY: THANK BROWN, MET-				
	α		Ŋ	14	100	80						
							6					
.s	्रम		58	76	100	75		CAY: TIME MEY, COMESTAE.				
			27	-	100	53	12	were weer, coessive.				
	۹.		42	17	100	78	12	SAMDY STLT: DARK MICHAEL GREY.				
.5	_											
							14					
	SM			w	100	49		SILTY SAID: DARK BROWN, FIRE TO REDICH GRAINED.				
						-						

DEPTH LOG MC 11 PT -4 -200 N PESCRIPTION STLTY SAID: BROWN, MOTST, HON-CO-S¶ 11 ¥P 99 42 3.0 SAMBY SILT: RADAN, MOIST, FINE GI ML 17 9 96 94 5.0 32 STUTY SAMP: 1,10HT HROWN, MOTEST. SM 6 NP 99 21 25 13.5 6 10 100 27 14 15 19 190 51 19 4P 100 51 19 SANDY SILT- BROWN, MOIST, STHE! THETY SAME: LIGHT BROWN, MOIST.

5 PLAY: NACHA, MET, COMESTIVE.

(H 58 53 29 100 92

23.5 PL 54 MP 100 N7 5 SANDY STLT: BROWN, NET. 25.5

TH83-2409 STA 147400 L

TH83-2409

SAFE: PROM, MET, CAVING.

EL . 252

TH83-2406

HES,

AVEL.

SAC

1	Ь					==
1	12	A 1704	100 L			EL - 29t
٩	al.	Pį	-4	-200	1	DESCRIPTION
-		*	99	28		SILTY SAMT: BROWN, MOIST, OCCASIONAL GRAVEL UP TO 3 INDES-
1		*	100	72		SAFE: FLEAN SAND, NO GRANEL.
1		۳	99	.9	Я	
		*	97	26	15	
į		₩P	100	39	19	SME: FINE GRAINED SAND, LENSES OF GREY SILT.
		φ	*5	23	••	SME: "EDIUM GRAINED, CHUNK OF M^{\prime} C TO 3 INCHES, MON-CONEST/F:
1		¥P	39	19	8	SAME: CIGHT BROWN, FINE GRAINED SAMD, NO GRAVEL, COOSE-
		₩2	100	27	g	SAF Security Motors
1		**	100	t!	·	CARTIVED TY SAME - LIGHT BROWN, FINE GRAINED SAME, CAVING, MOY-CONESIVE-
1	54	Ŧ?	(00	67	14	SARTY CLAY PROMI. MOIST, COMESTVE-
1	274	5	[00]	77	-	TANKY SWITH MIGHT, MOIST, CONESIVE-
1		100	100	Ŋ		STEP SHIP HET.
1	23	74	(30)	87	÷	CLAY TREY, PLASTIC, SOFT-
١	29	,	100	n	3	SAMOY TAY BREY, FINE GRAINED SAMOS, CAVING FROM ABOVE-

TH83-2409

				00-2403
3fa 147	+00 L		_	£L - 25 4
PI	-4	-200	•	DESCRIPTION
*	99	Q		SELTY CARE: BROWN, HOIST, HOW-COMESTVE-
•	16	54		SMPY SILV SHOWN HOLST, FINE GRAINED.
φ	76	17	72	SILTY CAND 15HT MORNIN, MOZETA
₩	373	21	21	
₩	110	27	n	
	139	51	19	SAMON OF A BARNAY, HOTSY, SIME CONFSTON-
	1.0	15		CELTY DAMN 1547 ARTHAIL HOIST-
₩]79		٠	SAF Torse with carries
מל	500	37	5	CAY Moran, HET, COMESTIVE
*	 av;	v	5	SMOY SET - SHOW, HET.
			3	***************************************

TH83-2407

TIB3-24	THB3-2407		51	TA 1574	00 L			P · 28#
DEPTH	L06	AC	u	PΊ	4	-200	1	DESCRIPTION
		10		ΨP	99	47		SILTY SAND: BROWN, MOIST, SOME COMESTON, ONE BOLLDER 4 INCHES X 10 INCHES
		9					45	
		y	3 NP 98 35					
	24	4		#P	97	14	58	SAME: LIGHT BROWN, NON-CONESTVE, GRAVEL TO 1 THOM-
10.5		4	-	#P	39	16	35	
	SM/SM	4		#₽	100	ıı	25	SMID/FILTY SMIT: LIGHT BROWN, METILUM GRAINED-
15-Q		10	-	*	100	22		SILTY SAND: BROWN, NEY, HON-CONESTIVE, CAVING-
	5 91							
		19		Ψ	100	16		
20.5 21.0	SI/SI	7		.	98	10	8	SMID/STILTY SMO: BROWN, SET, SOPE GPAYEL.

NOTES:

- ! SEE PLATE 24 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3. SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

SCALE: I M-3FT

				 					
SYMBOL	Mademont		042	APPECYAL					
	REVISI	ONS							
		U. S. ARMY BINGSHE LOS ANGER CORPS OF BING	LES	đ					
STEEROHED ST.	SANTA ANA R PHASE II GENE	IVER MAINSTEM, CALIFO RAL DESIGN MEMORAND	POMA UM						
SEAWN SW.	LOGS OF	LOGS OF INVESTIGATIONS							
	CORPS	OF ENGINEERS							
CHRONE SV	STA.175+	00 TO STA.147+0	X						
SUBMITTED ST:	DATE	MEC. NO. BACWOP-		94907					

TH83-2440

TW83-2	TW83-2440			STA 1	12+50 R		EL. 25±					
DEPTH	F06	ric.	: u	. Р	7 -4	-200	*	Description				
		12			100	32		SILTY SAMD: LIGHT BROWN, MOIST, NON-CONESIVE-				
							. 56					
		_					- ~	SAPE: PARC BROWN-				
	514	10		19	100	42						
							9					
		9		*	100	38	• •	SAME: 1,1987 BROWN				
		,		•	100	75						
1.0				·	100	39	. 8					
								SMIT/CLAYEY SMIT: LIGHT BROWN, MEDIUM TO FINE GRAINED SMIP, MON-CONESTIVE, 4 INCH THICK LAYER OF DMIKER FINE SILTY SMID AT 12-5 FEET.				
	3P/SC	4	32	11	100	12	14	SILTY SAND AT 12-5 FEET.				
5.0												
6.5	20/2H			NP	100	9		SAMP/STLTY SAMD: LIGHT BROWN, MEDIUM TO FINE GRAINED SAM MON-CONESTVE-				
		32	53	10	100	97	10	CLAY: LIGHT GREY TO LIGHT BROWN, CONESIVE, "INE GRAINED SAME, MATER AT 19-0 FEET.				
19.0	a	-										
		63	37	13	130	85	7					
.5						•						
	٦.		40	14	100	79	18	SAMDY SILT: DANK GREY TO BROWN, MOIST, COMESIVE, FINE GRAINED SAMD, ORGANIC-				
.5			~	.,	100	′,		GRALMED SAME, ORGANIC-				
	2	33	42	21	100	93		CLAY: THANK GREY, HOLST, ORGANIC-				
		39	35	9	100	97	10	STUT: LIGHT BROWLEN GREY, MOIST, SLIGHTLY CONESIVE.				
.5	۹.	41	43	15	100	89		SAFE: TARK GREY, PLASTIC, CONESTYE, ORGANIC-				
	<u>a</u>	35	44	70	190	85	5	SILTY TLAY: BROWNISH GREY, MOIST, COMESIVE, ALTERNATING 9 INCH LAYERS OF LIGHT GREY CLAY-				
·5	_	-						A MICH LAYERS OF CIGHT GREY CLAY-				
							27	SAMOY SILT: SHEY, MOIST, MON-COMESTIVE, FINE GRAINED				
	ą.	33		IP.	100	52		SAID.				
.5		29		160	130	37		SILTY CMD. Com.				
	\$11	_					37	SILTY SMID: GREY, HET, HON-CONESIVE, FINE GRAINED SMID.				
-		35		Ψ	100	44		SAME: GREVISH BROWN, ALTERMATING 2 INCH LERSES AT \tilde{g} INCH SPACING OF DAMK GREV ORGANIC SILTS:				
5			~				9	CARTO CAY				
		44	39	17	100	74		SAMOY CLAY: FINEY, MET, COMESTIVE, SHELL PRABMENTS.				
	æ						11	SAME: DANK GREY, MARY SMELLS, DAGANIC-				
		33	42	23	100	73		THE PARTY PRINT SPEELS, TRUMPHIC.				
0												

INVE	RT						_7	T79-4	
1179-4			2.	TA 140	+00 C				EL. 135
DEPTH	L06	MC	u	PĮ	4	-200	N		DESCRIP
		6		IP.	100	84		SAMEY SILT:	GREY, MOIST, VIS
	Ħ.								

CH 45 60 30 100 91

CLAY: GREY, NET-

TT79-4

SI	A 140	+0 0 €			EL- 132
Ц	PI	-4	-290	H	DESCRIPTION
	1 P	190	84		SMEY SILT: GREY, MOIST, VENETATION-
	₩	100	RI		
3 3	30	10C	 N		CLAY: GREV, WET-

TH83-2433

HB3-2433				A 138	+50 K			£1. 25±				
DEPTH	L06	HC	u	Pī	4	-200	H	Description				
	SM	10		NP.	100	32		SILTY SAND: EIGHT BROWN, MOIST, NON-CONESIVE, 2 INCH SILTY CLAYEY LINS AT 3 FEET-				
							45					
3.0							45	CLAYEY SAMD: LIGHT BROWN, MOIST-				
	SC	10	31	12	100	39						
6-0							19					
		•		NP	100	24		SILTY SAND: MOIST, NON-COMESIVE, MEDIUM TO FINE GRAINED SAND-				
						-	4					
	SPI	_						SAME: Fine grained sand-				
	311	6		MP	100	42		SATE: FIRE GRAPHED SAMP.				
							7					
		9		MP	100	36						
14.0												
	3P/SH	3		Ψ	100	10	10	SAMD/SILTY SAMD: MOIST, MEDIUM TO FINE GRAINED SAMD, MON-COMESIVE-				
15.0				_				CAMPA CILT. Major Fire Courses and a lost course				
	191	40	51	'nη	199	53		SARTY SILT: MOIST, FINE GRAINED SAND, SLIGHT CONESION, MATER AT 16-5 FEET.				
		-					12					
20-0 20-5		79	71	37	100	96 51						
20.5	a_	36	32	10	100	76	10	SANTY SILT: WET, SLIGHT CONESION, FINE GRAINED SAND. SANDY CLAY: LIGHT RROWN, MOIST, CONESIVE.				
22.0	54	37		10	100	46		STLTY SAND: BRN, NET, SLIGHT COVESION, FINE GRAINED SAND				
23-0		47		昈	190	78	22	SAFTY SILT: BON, WET, SLIGHT CONESION, FINE GRAINED SAND-				
		40		MP.	100	59	22	SAME: BRINISH GREY, WET, MED TO FINE GRAINED SHO, CONESIVE				
		33		WP.	100	61		SAFE: GREY, MOIST, CONESIVE, FINE GRAINED SAND-				
		78			100	94	14	SILT: LIGHT GREY, WET-				
	н.				100			SICI: LIGHT GREY, WET-				
		36		Mb.	190	51		SAMITY SILT: SLIGHT CONESION, MED TO FINE GRAINED SAND-				
		36		# P	100	89		STLT: LIGHT GREYISH MOON, FINE GRAINED SAND, CONESTVE-				
							17	SAFE: FREYISH BROWN, CONESIVE, LESS CONESIVE MITH				
				NP	100	33		INCREASE IN REPTH-				
34.0												
								SILTY SAFT: GREY, MOIST, NON-CONESTVE, FINE GRAINED SAFE				
	591	39.		NP	100	43						
							27					
39.0		-		F	100	- <u>\$1</u>	27	SATE: DANK GREY, MET, SLIGHTLY CONESION.				
		_			100	72	11	ORGANICS- SAFE: BANK GREY, COMESTVE-				
	_											
	٩	45		₩	100	73	24	SAME. GREVISH BROWN, SHALL SHELLS AND ORGANICS-				
		34		Mo.	[0]	- 77	.,					
		71		-	100	75		SATE: THANK GREY, MET, COMESTVE, FINE GRAINED SAND, MANY SHELLS, ORGANICS-				

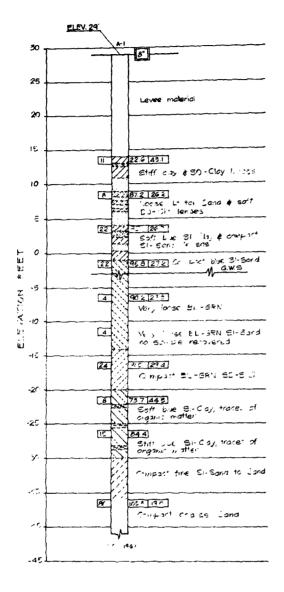


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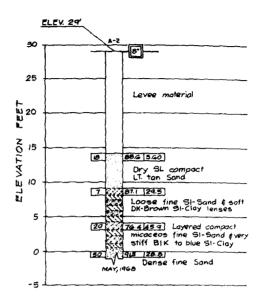
- 1 SEE PLATE 24 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE SA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3. SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4. ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE MOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

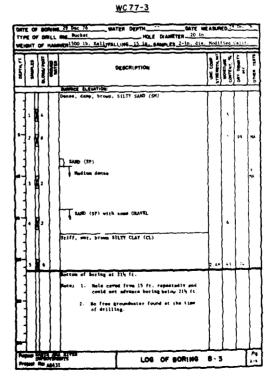
SYMBOL	MACHITICHA		OAR	APPROV
	REVI	IONS		
		U. S. ARMY ENG LOS AN CORPS OF E	36,85	a
SEEGHED BY.		RIVER MAINSTEM, CALI ERAL DESIGN MEMORA		
SEAWN ST.	LOGS	F INVESTIGATION	NS .	
l	CORP	S OF ENGINEERS	1	
CHECKED BY	STA. 142+	50 TO STA 138	+50	
	DATE	SPEC. NO. DACWOF.		-

OC 68-AI



OC 68-A2

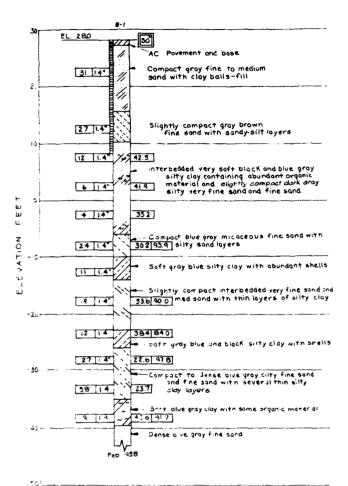




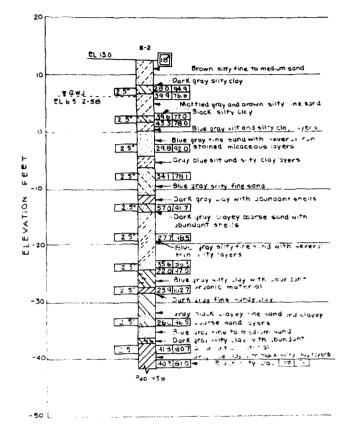
NOTES:

3.

OC 68-BI



OC 68-B2

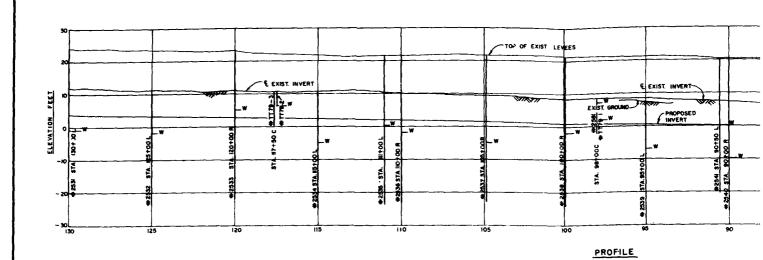


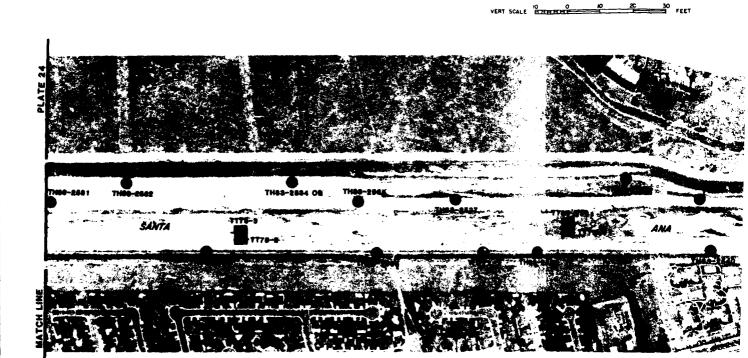
NOTES

- I. SEE PLATE 24 FOR TEST SITE LOCATIONS.
- 2. SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS.
- 3. LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE.

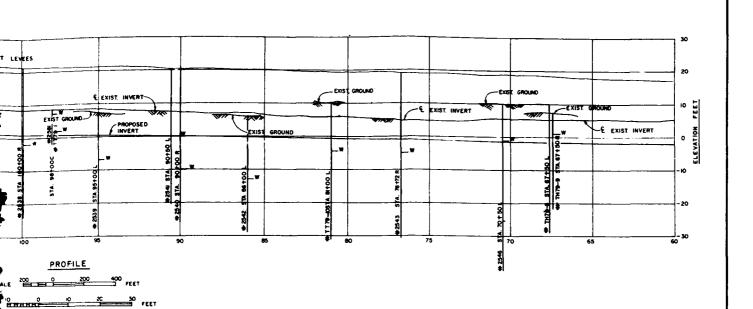
F										
Street	(6003790)46	MR	AFROVAL							
	REVISIO	ONS								
		U. S. ARMY BIGGINER DISTRIC LOS ANGELES CORPS OF BIGGINERS	ੜ							
ampun fr.	SANTA ANA RIVER MAINSTEN, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM									
STAWN ST.		LOGS OF INVESTIGATION BY OTHERS								
OROGE Ph	STA.195+00 TO STA.130+00									
BLOWITED SY.	DATE APPROVED.	SHEC. HO. DACWOP B	•							

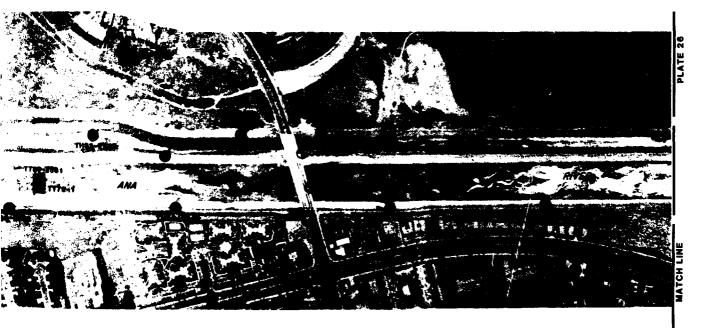
HORRZ SCALE 200 0 200 400 FEET













NOTES:

- I. SEE PLATE 8 FOR LEGEND AND GENERAL NOTES.
- 2. SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

PRINCE .	4107104										
	REVISIONS										
		NY BAGDAIRE DISTR LOS ANGELES PS OF BAGDARES	ici i								
		SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORMOUM									
COLUMN CO.	PLAN AND PR	OFILE									
STA.130+00 TO STA.60+00											

TH83-2531

TM83-2531				STA 1	20+0G F			£L. 24t				
DEPTH	LOG	HC	ш	P	1 -4	-200	H	DESCRIPTION				
								SILTY SME: BROWN, HOIST, MON-CONESTVE, MEDIUM TO FINE GRAINED SMED.				
	SH	5					58					
5.5		10					. 46	SAPE: FINE GRAINED SAND.				
		14						SAMDY SILT: DANK BROWN, MOIST, SLIGHT CONESION-				
	•	21						SAME: LESS SAND AS DEPTH INCREASES-				
		- 21						STE. CESS STEP AL DEFIN INDEXAGES.				
							21					
12.5												
13.5	8	13					37	SILDY SMID: DANK RECORD, HOLST, NON-CONESTVE. SMID/SILTY SMID: ROIST, NON-CONESTVE, FINE GRAINED SAND				
	26 \ 2K	u						SAME STATE CONTROL THE CONTROL SAME				
6.5							35					
8.0	5P	7						SAME: LIGHT BROWN, MOIST, MEDIUM TO FINE GRAINED SAND-				
	SM	15						SILTY SAMP: MOIST, NON-COMESIVE, FINE GRAINED SAND.				
1.2							11	PART ENT				
3.0	- SM	.53						SHITY SPIT: PARK BROWN, MOIST, CONESIVE. SILTY SAND: BROWNISH GREY, MOIST, SLIGHT CONESION.				
							13	SANOT SILT: BROWNISH GREY, MOIST, CONESIVE, FINE GRAINE SAND, MATER AT 25-0 PEET,				
25.0								CR. TV CR. M				
	a	49					3	STLTY CLAY: PROMY AND GREY INTERPLIXED, WET, COMESIVE.				
8.5								SAME: BANK GREY, COMESTVE, SHELL PRAGMENTS, ORGANIC-				
0.0	CH	40	76	43	100	99		CLAY: SMEY.				
2-ù	α	34					14	SMITY CLAY: LIGHT GREY, INTERMIXED WITH BROWN SILT, MEY, CONESIVE, FINE GRAJHED SAND.				
	sc	45						CLAYEY SAND: THANK GREY, SLIGHT CONESSION FINE BRAINED SAND, ORGANIC-				
1-0							23					
	2P./2C	37						SAND/CLAYEY SAND: GREY, MON-COMESTIVE, FINE GRAINED SAND				
		夏										
1.0	CH	40					16	CLAY: GREY, MET. COMPSIVE.				
.5												
-0	٩	5 0	32	7	100	77		SAMMY SILT.				
	sc.	13						CLAYEY SAND: THANK GREY, WET, NON-COHESTVE, FINE GRAINED SAND, SHELLS.				
								and and				

TH83-2532

TIMG	CDC	N IND				_	
	ORC			÷06 Ł			£L. 112
F08	MC	и	Pł	4	-200	,	DESCRIPTION
59/SI	16		_			20	SAND/SILTY SAND: MOIST, HEDIUM GRAINED SAN SANDY SILT: BROWN, MOIST, HOW COMESTIVE- SAND: MOIST, MEDIUM TO FINE GRAINED SAND-
- 32	20						SWID: MOISY, MEDIUM TO FINE GRAINED SAND-
4.	15					6	SANDY SILT: BROWN, MOIST, NON-CONESIVE, FI
56	27		_	==			SILTY SAID: LT MAL MOIST, NON-CONSV., FIN
a.	38					,	SILTY CLAY: LIGHT GREY WITH BROWN, MOIST,
						,	
me	42						SANDY CLAYEY SILT: GREYISH BROWN, MOIST, C GRAINED SAND,
						11	
CH	43	80	45	100	99		QLAY: GREY, WATER AT 13-0 FEET.
	45		_				TAKEY SILT; BROWN, MOIST, COMESTVE.
CH	53						CLAY: LIGHT GREY, VERY CONESIVE, SLIGHT IN
5"	*;		Ψ	130	29		SILTY SAND: FINE GRAINED SAND-
							SMIT/SILTY SMIT: HET-
	30					là	2min 25(1) 2min; set.
50/51	-						
	,,					24	
CN	39						CLAY: FREY, WET, VERY COVESTIVE.
ù	52					11	SMBY CLAY: BARK GREY, CONESTVE, SHELL, Y
SP/S#	78					74	SANT/SILTY SANT): FREY, WET. MON-COMESIVE, 30.0 PRET.
Q.	33					14	CANDY STUTY CLAY: SREY, CONESTVE, SINE CO.
	252 266 25/258 25 26 26 27 26 27 27 28 28 28 28 28 28 28 28 28 28 28 28 28	1312 1005 Mc 1005 Mc 1007 Mc	572 S LOS MC LL 59/59 16 59 20 11 15 58 27 CL 38 MH 42 CH 43 8C 15 CH 53 CH 55 CH 53 CH 55 CH 53 CH 55 CH 53	LOS NC LL PI SP/SP 18 18 59 20 41 15 58 27	572	572 STA 125-00 L 1.05 MC LL PI -4 -200 59-759 1.5 59-20 1.15 58-27 CL 38 FM 42 CH 43 80 45 100 99 1. 45 CH 53 CM 53 CM 76 CM 79 L. 52 CN 79 L. 52 CN 79 L. 52 CN 79 L. 52 CN 79 L. 52	572

<u>TT79-3</u>

TT79-5			\$1	117	450 C		EL. 11±			
DEPTH	106	MC	LL	Pļ	-4	-200	DESCRIPTION			
							 SAMPY SILT: GREY, MOIST, VENETATION-			
	4	5		9	100	34				
		10		₽	100	81				
7.0										
	OH.	45	50	33	100	91	CLAY: GREY, MOIST-			
0.0										

1179-2

1179-2			5	74 11 ⁷	•50 f			Sc. 118		
DEPTH	106	MC.	LL	PI	-4	-290	4			
		14			98	1		SAMD: GREY, MOIST, VEGETATION.		
	99									
		26			100	?		SME: Moist to MET.		
4.0										
¥ S.O .								NO SAPLE TAKEN: MATER AT 5.0 FEET-		

TH83-2532

25*	0 0 L			EL: 112
'I	-4	-200	y	DESCRIPTION
_			20	SAMD/SILTY SAMD: MOIST, MEDIUM GRAINED SAMD- SAMDY SILT: BROWN, MOIST, MORE COMESSIVE-
		_		SMID: MOISY, HEDIUM TO FINE GRAINED SAND-
			5	SAMDY SELT: BROWN, MOIST, MON-COHESIVE, FINE GRAINED SAMD.
_				CI N CHILL I THE WAY THE COURT OF THE COURT OF
-				SILTY SME: LT men. MOIST, MON-CONSY., FINE GRAINED SMED-
			_	SILTY CLAY: LIGHT GREY WITH BROWN, MOIST, CONESTVE-
			÷	
				SANDY CLAYEY SILT: GREVISH BROWN, MOIST, CONESIVE, FINE GRAINED SAND.
			11	
5	100	99		CLAY: SREY, MATER AT 13-0 FEET-
				LANTY SILT: BROWN, MILST, COMESTIVE
_				
				C.AY: LIGHT GREY, VERY CONESTYE, SLIGHT INCLUSIONS OF STLT:
Þ	197	ρ,		STLTY SAPD: FINE GRAINED SAND-
			1,5	SMR/SILTY SMIP: MET-
			34	
				CLLY. SHEY, HET, VERY CONESIVE-
			11	SANDY CLAY: "NARY GMEY, COHESTYL SHPLUS, ORGANIC-
			٦,	SAMPL/SILTY SAMP): GMEY, WET. MON-COMESIVE, SHPLLS RELOW 10-7 PEET.
_			14	SANTY SILTY (T.AY: SREY, COMESTIVE, FINE GRAINED SAND-
				2 AVEY SHIP: GREY, MET, MEDIUM TO FINE GRAINED SAND.

TH83-2533

TH83-2533			S1	A 120	-00 R			红. 2致
EPTH	L06	NC.	ш	Pl	4	-200	,	Description
	59/SM	9		ЖP	100	7		SAND/SILTY SAND: MEDIUM TO FINE GRAINED SAND-
3-0							48	
		13		180	96	13		SILTY SAND: MEDIUM TO FINE GRAINED SAND-
		9		-	100	- 33	14	
	SM	<u>,</u>			100			SAME: BRN, MOIST, MED. TO FINE GRAINED SAND, NON-CONESTV
		11		ΝР	100	18	9	SAFE: SREY-
		10			100	30		SAPE: PROMIN-
1-0	SP/SM	,		100			10	SMID/SILTY SMID; HOM-COMESIVE, FINE GRAINED SMID-
	32/30	•		180	100	10		
4.0		30	46	17	100	69	11	CLAYEY SAND SILT: BROWN, MOIST, FINE GRAINED SAND
	rt.							
18.0	-	30	42	14	100	61	12	SAME: MET, TRACE OF CLAY, CONESIVE, WATER AT 13-0 FEET-
9-0								
	**	41	51	29	100	92		CLAYEY SILT: BROWN, WET, COMESTVE
2.0							v	
	a	44	44	18	เกด	30		SAMPY CILTY (LAY: BROWN, MOIST, COMESIVE, FINE GRAINED SAMO-
							15	
6.0	СН	32	62	34	100	94		TLAY: RROWN, MOIST, SOME RIST COLOR-
7.5		- - -	- 12	14	100			CLAYEY STUT: BROWN, MOIST, COMESTVE
8-5							11	
0.0	741	5n	81	42	100	95	12	CLAYEY SILT: "DRGANIC, BLACK, MOIST-
	CH	40	52	28	100	34		SANDY CLAY: BROWN, SREY AND 9LAOK, CONESIVE-
	-un	T)						
4.0			- 57 - 37	Z4 17	100 100	89	11	CLAY: BLACK, WET, FON SPELLS-
		32	34	0	ruo	63	21	SANDY SILT: PARK GREY, MET, COMESIVE, FINE GRAINED SAND
							Ą¢	SATE: MEDIUM GRAINED SAND, SHELLS-
	٩	41						
		II.		P	100	- 30	æ	CMMW CLLT. Entry powerpar supple
		7	刻	- +	100	- 52	25	SAMITY SILT: ARREY, COMESTIVE, SMELLS
3.5								
5-0	5"	79		₩P	100	20	26	SILTY SAND: GREY, WET, SHELLS-

TT79-2

CL. 118

CL. 118

SAMD GREY, MOIST, VEGETATION:

SAME MOIST TO MET.

MO SAMPLE TAKEN: MAYOR AS 5-0 punts.

NOTES

- I SEE PLATE 25 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
 - 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM.
 - 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
 - 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNILESS OTHERWISE NOTED AS "INVEST" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



SYMBOL	BESCHIFTIONS	 	DATE	APPROVAL						
	REVIS	IONS								
		U. E. ARMY ENGINE LOS ANGE CORPS OF ENG	LES	7						
MERCHAN 57.	SANTA ANA RIVER MAINSTEM, CALIFORNIA PHASE II GENERAL DESIGN MEMORANDUM									
SEAWN DO.	LOGS OF INVESTIGATIONS									
	CORPS OF ENGINEERS									
CHICKIN IN	STA.130+00 TO STA.117+50									
SUBMITTED BY:	DATE APPROVED	SFEC. NO. DACWOF		SHEET						
l		DESTRUCT BLE NO		1						

~		CD	St (Bur			TH	83~	<u>2534</u>			
XIST 183-253		GA		2 A 1154	00 L	EL- 112					
EPTH	L06	PC	ш	PI	4	-200	H	DESCRIPTION			
	281	8		NP.	100	16		SILTY SAND: BROWN-GREY, MOIST, NOW-COMESTVE, MEDIUM GRAINED SAND, SOME GRANGE TO 1 INCH-			
-1	т.	27		₩	100	91	229	SILT: BROWN TO LIGHT BROWN, MOIST, NON-CONESIVE, FINE GRAINED			
	1	26	3 2	- 6	100	72	42	SAMEY STAT: BROWN, MOIST, NON-CONESTVE, MEDIUM GRAINED			
7.0	α	31	43	υ	100	86	12	SILTY CLAY: BROWN, MOIST, NON-CONESIVE, FIME GRAIMED SAND.			
0-0		53	52			91	16	CLAYEV STLT: BROWN, MOIST, COMESTVE-			
	194	43		w	100	97					
5-0 16-0 6-5	4			w.	100	89		SILT: GREY, MOIST, COMESIVE, WATER AT 16-0 FRET-			
		41		*	100	38	23	SILTY SAMP: FARY, WET, NON-COMESTIVE, FINE GRAINED SAMD, 9 INCH CLAYEY SAMD LAYER AT 17-5 FRET-			
	SPI	29		₩.	100	5,	25				
		31		Ψ	100	50	43				
5.0							10	SAMOY SILT: GREY, NET, NON-CONESTYE, FINE GRAINED SAMO			
	4	52		₩	100	51					
3 0.5		23	35	19	100	51	· 9	SATE: SOME SHELL PRINCHENTS-			
51.5	sc_	_27	30	9	100			CLAYEY SAND: GREY, WET, HON-COMESTIVE, SHELL FRANKBITS.			
	SM			₩	100	3 0		SILTY SME: GREY, MET, NON-COHESTYE, FINE GRAINED SAND SHELL PRABMENTS:			
33.S	2		u6	24	10º	90	•	CLAY: GREY, MET, COMESTYE-			

<u>TH83-2535</u>

THB3-2535			\$11	A 111+	00 L			£. 21±
DEPTH	L06	HC	u	PI	4	-200	N	DESCRIPTION
	M.	13		Ψ	100	58		SAMOY SILT: RICHH, MOIST-
3.0							47	
_ <u></u>		17	36	16	100	57	4/	SMITTY CLAY: BROWN, MOIST-
	α	70	39	17	100	76		
5.5							28	SILTY SAND: BROWN, MOIST, FINE GRAINED SAND.
		14	25	4	100	44		SICI SHO: DICES, 101317
						37	28	
		11		¥P	100	3/		
							44	
	SM	11		*	100	41		
		_						
		3		40		36	22	
		3		•	100	360		
		_					24	SAME: 3 THOH LENS GREY SAMO/STLTY SAMD AT 17-5 F
19-5		12		₩:	100	34		SAME: GREYISH BROWN-
	a							STETY CLAY: "DARK BROWN, I INCH LENS LIGHT GREY M GRAINED SAND:
20.5							9	CLAYEY SILT: GREY, WATER AT 21-0 FEET-
	194	43	óμ	50	100	98		
23.5								
		44	74	44	100	95_		CLAY: GREY- SANDY CLAY: GREY AND DARK GREY, MICACIOUS-
	Сн	34_	_5ï	_2:	100	5		(LAY: GREY-
<u>27.0</u>		-54	58	30	100	97	7	
	194	39	53	74	100	80		SAMOY SILT: PREV-
29.5							16	
		36		¥	100	60	•	SMEDY STLT: PLACK, SHELL PRACHENTS.
	4	33		*	100	50		
	•	32		7	100	51		
		.78	3)	—· ·,	100	§1	33	SME: "TARK GREY AND BLACK-
37.0 37.5								
37.5				<u>Y</u>	100			STETY SMID: DARK GREY AND BLACK, SHELL FRACTENT
	SD-84	25		¥	100	12	38	SAMD/SILTY SAMD: BANK GREY AND BLACK, MONTCHES 30 PERCENT SHELLS:
40.5 41.5		95			100		-	SMOY SILT: DARK GREY MO BLACK, SLIGHT CORES;
41.0	Л						- 22	SILTY SAND: THANK GREY AND BLACK, WET, TRACE >
	44	47		*	100	44		50 PERCENT WELL FRAGMENTS:
43.5	20-2	30		4	100	 -	-	SMIT: DARK GREY AND BLACK, MET-
#3:5	ন্	95	51			90	-	FAT CLAY: SREYISH BLACK, HET:

TH83-2535

щ	1+00 L			EL · 21±
PI	-4	-200	4	DESCRIPTION
•	100	58		SAMOY SILT: MROWN, MOIST-
			4.	
16	100	52		SANTY ELAY: PRONN, MOIST-
<u> 7</u>	100	75		
4	100	34	29	STUTY SAND: BROWN, MOIST, RING GRAINED SAND
₩	100	5/	29	
*	:00	41	44	
			37	
*	!00		٠,	
*	107	t _u	•	SAME: 3 THOH LENS GREY SAMD/STLTY SAMD AT 17-5 PEET- SAME: PREVISH BROWN
				GRAINED SAND.
12	100	æ	٠	CLAYEY SILT: SHEY, WATER AT 21-0 FEET.
42	100	15		CAY SHEY. SARY CAY SHEY AND DANK GREY, HICACIDIS.
23	120	-33		CARCY CLAY - SREY AND DANK GREY, HICACITUS- CLAY- SREY.
30	100	-1'	•	
? 4	iX.	9 0		TMMNY SILT Geey.
•	190	57	[#	CHAPY CITY BLACK, CHELL EPACHENTS.
	;x	\		
	<u>!</u>	37		
	L71	`	*;	ATE CAR SREY MD BLACK
	: X		ч	SAND/SICH SAND TANK GREY AND BLACK, MON-COMESTVE. SAND/SICH SAND TANK GREY AND BLACK, MON-COMESTVE. TO PERCENT SHELLS.
1	T	. . .		THE SEC MO BACK, SIZER CORSION.
P	m	144	22	OT ITY SAME "MANK GREY AND BLACK, MEY, TRACE OF CLAY, 5" OFFICENT SHELL FRAMMENTS.
	y.			THE DARK GREY MED BLACK, NET.
	I	7		AT CLAY: "REYLSH BLACK, MET.

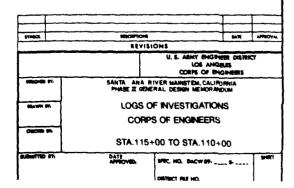
TH83-2536

						-44	-	<u>2006</u>
TH83-2	536			STA 11	0+00 R			EL. 21±
DEPTH	L06	MC	u	PĮ	-4	-200	*	DESCRIPTION
2.5	24	16		Mo	100	29		SILTY SAID: MOIST, HON-CONESIVE, MEDIUM TO FINE GRAIN SAID.
5.0	SM/S	15		NP.	100	1?	20	SAND/SILTY SAND: LIGHT BROWN, MOIST, 4 INCH LAYER BRO SANDY SILT AT \$15 FEET, FEB 3/8 INCH GRAVEL.
		8		NP	100	40	53	SILTY SAND: RROWN, MOIST, MON-COMESSIVE, 4 INCH LAYER MEDIUM TO FINE SRAINED SAND.
	SM	5		¥Ρ	100	36	13	SAME: LAYERS OF FINE GRAINED SMODS AND SILTY SAMOS-
		v		Ψ,	99	31	10	SAME: MORE STLY AS DEPTH INCREASES.
14.0		27	58	36	7.00	30	19	SAME: MORE SILT AT PEPTH INCREASES.
	CH		54	"	100	 S0	16	SANDY CLAY: GREY AND BROWN, MOIST, COMESIVE.
0.5 22.0 3.0	4	45	60	27	100	 46	13	CLAYEY SILT: GREY-BROWN, CONESIVE, MATER AT 27.0 FEET.
3.4		39	72	39	100	97	20	G.47: SREY, 40(ST.
9.5	C#	 53	52	39	100	ŝa	4	SAMPY FAT (J.AY: SAME, LIGHT SREV-
	44	35	73	4?	100	47	5	CHAPPY SILT: Serv, COMESIVE, SMPLLS, ORGANIC
2-1	٦.	33	39	?	130	55		SAMEY SILT: "MARK GREY, MOIST, SLIGHT COMESION, SHELLS, DROWNIC-
i.S	34	۰	~ 	40	130	19	E	STETY SANT: DARK GREY, NET, NON-CONESTNE, SHELLS-
1.0	Ø₽/ØH	23		 140			39	SMOJCILTY CAYN: SREY, MET, MON-COMESTVE, SOME SHELLS-
۵.	yr1	45		7	*/	3		
.0	8	51		¥P.	100	_7_		CANCE THE LIGHT ODEN HET CHOICE.
-W	SH .	29			100	23		SHEY SAMO: DARK GREY, HET, SHELLS: SILTY SAMO: DARK GREY, HET, FINE GRAINED SAMO:
		47		,,-	100	4.3		THE STATE OF THE PART OF THE PART PART PART PART PART PART PART PART

NOTES.

- I SEE PLATE 25 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2. SEE PLATE 84 FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.





TH83-2537

THES	-2597			STA 1	05+00 L			E. 71t
DEPT	N L06	HC	ш	P	1 4	-200	н	DESCRIPTION
		16	39	2	0 100	n		SAMDY CLAY: BROWN, MOIST-
	a						32	
		21	40	19	5 100	84	-	SAFE: LIGHT BROWN, MOIST-
5.5							-	
	SPI	9		ış	100	41		STETY SAMD: ETBAT BROWN, NON-CONESTIVE-
9.0							16	
10.5	SM/S	v	25	6	100	45		STLTY SAND/CLAYEY SAND: BROWN, MOIST, HON-COHESIVE.
	rt.	14	29	6	100	58	28	SWEY SILT: 1,18HT BROWN, MOIST, 1 INCH LENS QLAY, 1 INCH LENS DECOMPOSED MODE:
13.5	a .	21	41	22	100	79	26	SAMPLY CLAY: LIGHT BROWN TO BROWN, MOIST-
16.0	571	13		₩	100	44		SILTY SAND: GREY, MOIST, HON-COMESIVE
13.0	u	32	47	71	100	31	16	SAMOY CLAY: BROWN, MOIST, COMESIVE, 172 INCH INTERNITTENT
19.5							10	SILT LENS-
	791	51	80	25	100	94	14	CLAYEY SILT: RINGH, MOIST, COMESTVE, ORGANIC, SILFER COOR, 2 INON REACK LEWS.
23.0	СН	42	55	37	190	98	15	CLEY: BROWN, MOTST, CHESTME.
25.5 ¥ 26.0		36	34	,	100	83	-	SARTY SILT: GREYISH BROWN, MET, MON-CONESIVE, MATER AT 26-9 FEET.
	A.	32	37	à	100	98	20	SILT: SAME, GREY-
30.0		n		*	190	15		SILTY SAND: GREY, NET, HON-COHESIVE, FEN SMALL SHELL
	24						22	FRAGRENTS.
59.0		?8		**	100	47		
35.2	Y/X	_26		·P	100	11	15	SMP/STLTY SMIT: GREY, HET, HON-CONESTVE, NO PERCENT SHELL FRAGMENTS:
37.5	591	26		*	170	15		STELLY SAME: GREY, WET, MON-COMESTIVE, AT PERCENT SHELL FRAGMENTS.
39.5	SP/S#	29		40	100	8	71	CAMIT/STILTY SAMIT: GREY, NET, HON-COMESTIVE, 20 PERCENT SHELL PRAGMENTS.
		73			100		,	SMID: GREY, NET, MON-CONESIVE, SHELL PRAGMENTS.
	',ο	27			100	-	10	
<u> 14. 2</u>							10	

TT79~1

179-L			3	TA 98+	973 C			€L+ 9±
EPT4	L06	4	Lu.	Pī	•	-200	*	DESCRIPTION
	3 #	11		•	94	19		STLTY SAMP: LIGHT BROWN, MOIST, WEED GROWTH-
L		79	FT	9	100	74		SANTY SILT: FINEY, NET, MATER AT 7-0 FEET-
<i>I</i> .a		·		13	100			SANDY CLAY: BLACK, NET, ORGANIC SPELL.

TH83-2538

7/83-7 	2538		S	TA 100	P 00+C			EL. 21±
DEPTH	106	ж	ū	PI	4	-200	Ħ	DESCRIPTION
1.0	SP/SP	- 4		MP	99	11		SAND/STLTY SAND: BROWN, MOIST, NON-CONESION
		11		MP	99	40		SILTY SAND: LIGHT BROWN, NON-CONESIVE, MEDI GRAINED SAND-
		20			99	49		SAME: BROWN, MOIST, FINE GRAINED SAND-
		_					19	
	24	12		r	100	41		
		9		₩	100	37	15	
		12		¥	100		11	
		14	74	7	100	45		
								SAME: GREY-BROWN-
		5		*	99	14	,	
6.0								
		30	53	24	100	77	13	SANDY CLAY: BROWN, MOIST, CONESIVE-
	CH	36	5/	29	100	94		CLAY: WATER AT 23-0 FEET.
		48	58	3 0	100	96	15	į
23.0								1
		36	58	27	100	95	16	SILT: "ROWN, MOIST, CONESIVE-
	M	92_	55	22	100	-98		SME: GREYISH BROWN-
g -	- CH	85	55 69 57	23.	100	- 86 99 54	5	SAFE: DARK BROWN, CONESIVE, ORGANIC
.5 28 (103	57	17	100	54	•	SAMILY SILT: DARK GREYISH BROWN, CHESTVE, SA
28 0)	32	37	12	100	60		SANDY STET: DARK GREY, COMESTME, SHELL TRAG
	n.	32		4 5	100	55	30	SAME: PRE:NIC-
		32		Ψp	100	30		SAFF: FIREY, SLIGHT CONESION-
1-0	_						19	
.0	50 /SM	29		40	90	8		SAND/SILTY SAND: GREY, HET, 50 PERKENT CO
		>5			98	4	57	SAMT: PARK GREY, NET, 25 MERCENT SHELL FOR
	20							
		95			95	4	17	SAFE: 17 PERCENT SHELL FRAGMENTS.
.0	- A -		-	-,	-		5 4	
.0	PL 97/5H	29 75	47	11	110	54		SAMIY SILT: DAW GREY, WET, COHESIVE [T
<u>Q</u>	y/3n	/3			[চ্যা	3		SMO/SILTY SMID: TANK GREY, WEY, FEW THE

TH83-2538

	Pi	4	-200	H	DESCRIPTION
_	NP.	99	-11.		SMD/SILTY SMD: BROWN, MOIST, NON-COMESION-
	MP	99	u(:		CILITY CAND: LIGHT BROWN, NON-COMESTVE, MEDIUM TO FINE GRAINED SAND.
_	*	99	43		SAME: BROWN, MOIST, FINE GRAINED SAMO-
_				19	
	۴	100	a'i		
				15	
	*	178			
_	7	100		:	
					SAM REY-BROWN.
•	₩2	99			
-	24	100			SMITY CLAY: BROWN, MOISE, COMESTVE
				1*	
	.79	:00	, i.		CAY WATER AT 23-0 FEET.
	\$ O	:x	>	15	
	27	100		15	THE ROWN, MOIST, COMESTYS-
_	_22	ir.	X_		SAME - GREYISH BROWN-
_	- 21	**	_	r	AN THE BROWN, CONESTVE, ORGANIC: AV SHEY, CONESTVE. THEY STILL TRADERITH BROWN, CONESTVE, SHELL TRADERITH
-	12	:00:			TANCY SILT DARK GREY, CONESTIVE, SHELL STAGMENTS.
	*	70.		ŧ:	SAME JAKINIC
	φ	ж			CAME PRIEST CONESTON-
	4 0	23		13	FANCET TY SAND GREY, WET, ST PERCENT SHELL FRAGMENTS
_		76	- :	,-	"UNT TANK GREY, WEY, TS DERCENT SHELL SPACHENTS.
-		¥,			TAPE O PERCENT SHELL PRABARITS.

REMOVELLY THAN SERV, MEY, COMESSIVE, IT PERCENT SHELL PROPERTY.

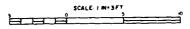
AND THE SMALL PROPERTY.

TT84-258I

1 NVE 1184-25			\$1	A 98+	ю с			£L. 8#
DEPTH	L06	HC	u	ΡĮ	-4	-200	H	DESCRIPTION
¥1.0 2.0	SP/SH			Mp.	100	5		SAND/SILTY SAND: MULTICOLORED, MOIST TO MET, MEDIUM TO FINE GRAINED SAND, OCCASIONAL GRAVEL, MATER AT 1-0 FEET-
	M.		33	6	100	62		SANDY SILT: DANK BROWN, WET, COMESTIVE-
5.0				_				
7.0	CH		85	54	100	93		CLAY: LIGHT GREY WITH BROWN AND RED VETNS OF ORGANIC MATERIAL, CONESTVE
	SPI			Mb.	100	29		SILTY SAND: DARK GREY, NET, COHESIVE, FINE GRAINED SAND
10.0								

NOTES

- 1 SEE PLATE 25 FOR LOCATION OF TEST HOLES AND TEST
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTEO AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE



SYMBOL	DESCRIPTION		DATE	MANOAM					
	REVI	SIONS							
		U. S. ARMY ENGI LOS AND CORPS OF ER	PELES	cī					
DESIGNED BY:	SANTA ANA PHASE II GEI	RIVER MAINSTEM, CALIF VERAL DESIGN MEMORAL	PORINIA NOUM						
DEAWN BY.	LOGS OF INVESTIGATIONS								
	CORPS OF ENGINEERS								
ORCHO SH	STA:105+00 TO STA:98+00								
SUBMITTED BY:	DATE APPROVED	SPEC NO. DACWOP.	b	94007					
		DISTRICT PLE NO.							

TH83+2541

							Ţ	H83-2539
EXIS		GRO) STA 95	•00 I			ել, <u>8</u> ±
								
DEPTH	L06	HC	u	PĪ	4	-200	*	DESCRIPTION
	M.	19		₩P	100	65		SANDY SILT: BROWN, MOIST, MON-COMESIVE.
3.0							. 14	
4-0		19_	.46	21_	100	82		SMIDY CLAY: TANK BROWN, MOIST CONESTATE.
5.0	SH	13	24	2	100	29		SILTY SAID: LIGHT BROWN, MOIST, NON-CONESIVE-
5.0	CH_	10_		MP	100		. 17	SAMITY SILT: LIGHT BROWN, MOIST, NON-COMESIVE
7.0 8.0	- 11	.14		MP.	190 190	98_ 54		CAY: BROWN HOIST, CONESIVE.
<u>g.u</u>					120	29_	. 6	SAMTY SILT: PROBEL MOIST, MON-COMESIVE. SAMTY CLAY: PROBEL MOIST.
	ď,	44	#8	25	100	79	0	Servi (Ent. mediat, motor.
1.0								
		<u>a</u>	n	40	100	70		SAMINY (S.AV. Borney, HOLEY,
	CH	R			196	48		SAMINY CLAY: BROWN, HOIST- CLAY: GREY, MOIST-
4-0								
15-0		33	75	_4	188	54		SAMBY SILT: BORY, MOIST, NON-CONFSIVE MATER AT 15.0 ET
	M.	發 奶			190	- K		SMBY SILT: GREY, MOIST, NON-CONESIVE, MATER AT 15:0 FT. SME: GREY-BROWN, MET, SOME CONESION- SME: GREY, NON-CONESION-
5.5							33	
	80				1:30	2		SAND: GREY, WEY, 40 PERCENT SHELL PLAGMENTS.
3.2								
		27		180	10n	4	14	CAMB/STILTY SAME: GREY, HET, 13 PERCENT SHELL GRADMENTS.
		2,		*	5.46	٠		
	\$P/\$M							
				Yp:	inn	5	3	SAFE: FON SHELLS.
				•	.5	,		
.0								
								SANT: GREY, WET, 40 PERCENT SHELL FRAGMENTS.
		3.1			1,00	ŧ		
	_	2/			130	2_	22	SAND GREY, HET, 40 PERCENT SHELL FRAGMENTS.
	\$	27			()n	4		CAME. FEW SHELL PRASHENTS.
		75			TO:	~		SAME AT PERCENT SHELL PRAGMENTS.
							10	Service Course datas
		27			199		37	
<u></u>								

DEPTH LOG				STA 99	+50 L		€1. 202
DEPTH	L09	МС	Li.	PI	-4	-200	N DESCRIPTION
3-0	9P-SH	17		₩	.30	,	SAND/SILTY SAND: LIGHT BROWN, DRY, F
	sc	10	29	12	100	49	CLAYEY SAND: BROWN, MOIST, FINE GRAIN
8.5	sc.	6	41	18	100	19	SAME: BROWN AND GREY-
		23	31	:7	120	67	SAMDY CLAY: DANK BROWN, MOIST, FINE O
	a						
		25	47	72	170	71	
		29	47	33	727	75	
5.5		70-	3		1.0	70	SAME: BROWN-
7.0	٩	25	57	· · · · ·	130	68	SAMMY CLAYEY SILT: "ROWN, MOIST, FINE
8.5	ı	45	42	1,	130	¥6	SILTY CLAY; DARK BROWN, MOIST.
20-0 3-5	СН	29	Si	24	1.0	92	CLAY: DARK BROWN, MOIST. SAME: LIGHT GREY, WATER AT 23-9 FEET.
	sc	34	41)	16	ini	21	CLAYEY SAND: BROWN AND GREY, SATURATE
13	975 1			W	7.55	_11	SMO/SILLY SAMO: SREY AND GREEN.
		35	56	٤.	:ກ	14	STETY SAND: BARK GREY AND MIXED WITH
		72	£: _		[1]	٦٢	SME: THANK GREY, WHETE BROVEN SHELLS.
	SM.	29		*		43	SAME: TARK GREY WITH BROWN.
				V F	ins.	49	SAME: BARK GREY-
.5	ςρ	•					SAND: DARK GREY, COARSE TO FINE GRAINE
<u></u>					122		FR AGMENTS.
				/			SAND/CLAYEY SAND: DARK GREY, WHETE SHE
					1.01	_	

TH83-2541

MD -

90+	50 L		EL . 20±
ΡĮ	-4	-200	N DESCRIPTION
₩P	100	,	SANOVSILTY SAND: LIGHT BROWN, DRY, FINE GRAINED SAND
	100		CLAYEY SAND: BROWN, MOIST, FINE GRAINED SAND-
19	100	19	SIME BROWN AND GREY-
ļ.	130		SMOV (LAY - DARK BROWN, MOIST, FINE GRAINED SAND-
77	101	- 1	
2 8 2	130	- 75 - 70	SME BROWN
ş	100	58	TANDY QUIYEY SILT: ROOM, MOIST, FINE GRAINED SAND.
19	100	*	PT_TY FLAY, DARK BROWN, MOIST-
. 4	1.0	eť.	CAY DARK BROWN, MOIST
:5	100	2.	CAYEY SAND: BROWN AND GREY, SATURATED
₽.	100		SAMO/SILTY SAMO, GREY, AND GREEN-
5.7	100	[4	O' TY SAME. THANK SHEY AND MIXED HITH BROWN-
₹*-	110	Įĸ	THE - THE GREY, WHITE BROKEN SHELLS
₩C	j.r		TAME THAT GREY HETH BACKEN.
4 ¢	196	+3	"AME TARK GREY.
	; 7	•	TAN DAM SHEY, IDAMSE TO FINE GRAINED SAND, SHELL TRACHENTS:
			TANT TLAYER TANTO THANK GREY, WHITE SHELL PRABMENTS

TH83-2540

H83-25			- 31	A 90H	JU K			EL- 202
EPTH	LOG	MC	u	Pį	4	-200	H	DESCRIPTION
		9		ΝP	100	13		SILTY SAMD: LIGHT BROWN, MOIST, MEDIUM TO FINE GRAINE SAND, NON-COMERIVE.
		_					12	
		8		ЖP	199	24		SAME: BROWN-
							20	
	SM	11		ųР	100	41		SAFE: LIGHT BROWN, FINE GRAINED SAND
		7		MР	100	29	8	
		14		ĦР	100	38	6	
		4		NP.	100	16		
3.5	n.	74	37	18	100	55	17	SAMBY CLAY: FREY-BROWN, MOIST, COMESIVE-
5.5								
	194	34	52	22	100	88	11	SILT: GREY-BROWN, MOIST, COMESIVE-
3.5	-							
1.5	CH	41	57	35	100	91		CLAY: "MARK BROWN, MOIST, COMESIVE-
).5 .0 .0	đ	\$5	49	23	100	93		O AYEY SILT: LIGHT AROWN, CONESIVE, TRACES OF CLAY. SILTY CLAY: GREY, MOIST, STIFF, CONESIVE.
1.5	СН	39	78	47	100	92		CLAY: LIGHT GREY, MOIST, STIFF, COMESIVE-
	SM:	31		Ψ	100	37	29	SILTY SAKO: PARK GREY, WET, NON-CONESIVE, ORGANIC-
5-5	•							
· · · · · · · · · · · · · · · · · · ·								SANDY (LAY: NAMY SREY, WET, WATER AT 30-0 FEET.
	Q.	35	39	ts	100	84	34	
30.0	u.							
							27	
2.5								SILTY SAMD: BARK GREY, MET, NON-COMESTIVE, COMMISE TO GRAINED SAMDS, 20 PERCENT SHELL FRAMENTS, ORGANIC-
	514	26		мр	97	15		GRAINEU SANUS, ZU PERCENT SHELL FRAGMENTS, ORGANIC-
6.5							19	
		25		40	35	11		SAMB/SILTY SAMB: "MAK GREY, HET, NON-CHIESTVE, 10 TE SHELL FRASHENTS, ORGANIC-
	GD/SH						25	SAME: 5 PERCENT SHELL FRAGMENTS-
	- 7 (37)							SAFE: 10 PERCENT SHELL FRARMENTS.
								OFFICE ACCEPTAGE STELL FORESTISS
5-0							26R	

SCALE: I M+3FT

NOTES:

- 1. SEE PLATE 25 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2. SEE PLATE SA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3. SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

SYMBOL	DESCRIPTION	BARI	APPROVA					
	REVI	SIONS						
		U. S. ARMY ENGINEER DISTRI LOS ANGELES CORPS OF ENGINEERS	CT -					
0000-00 IV.	santa ana river mainstem, california Phase II general Design memorandum							
SEAWAY ST.	LOGS OF INVESTIGATIONS							
	CORP	S OF ENGINEERS						
CHROMO SH	STA.95	5+00 TO STA.90+00						
BURNITIED SY.	DATE	MIC NO. DACWOP.	34007					

TH83-2542

THB3-2	TING 542			STA 86	+00 L			EL- 7\$								
DEPTH	L06	RC	u	PI	-4	-200	*	DESCRIPTION								
								SAMPY SILT: Recent, MOIST, MON-COMESTVE-								
	A.	15	44	7	100	56	_									
		-77		-18	100	- en	. 38	CASE. POSTERIO								
9.5		23			100	50		SAME: COHESTYE-								
i.5	SC	14	41	19	100	45	398	CLAYEY SMID: GREYTSH BROWN, MOIST, SOME CLUMPS OF SILT-								
	SPI	9	50	21	100	20		SILTY SMID: GREYISH BROWN, MOIST, NON-CONESIVE, MEDIUM TO FINE GRAINED SAND-								
	α	21	4.7	24	10^	72	24	SANDY CLAY: BROWN, MOIST, CONESTVE, SHELL FRASMENTS-								
.1	٠	72	F4	31	100	5.7	24	SAMPY SILT: BROWN, MOIST, COMESIVE, SHELL FRAGMENTS-								
.0	•	••		^	100	<i>.</i> .		Jan - Vict. Brown, Forst, Committee, Street Principalis-								
.5	581	18	62	23	100	48		STLTY SMITH: LIGHT BROWN, MOIST, NON-COMESTVE, SOME SHEL PRAGRESTS.								
		24	48	21	100	51	24	SANDY (LAY: GREY, MOIST-								
	α	23	42	19	100	56	30	SAPE: SLIGHT ORGANIC SHELL, MATER AT 20-0 FEET-								
20.0 .5	3	23	- 57 61	Į.	100	69		SANDY SILT: GREY, WET, ORGANIC, ROOTS-								
.5		<u>"</u>		<u>~</u>	100		18	CLAY: LIGHT GREY, HOIST-								
	sc	29	45	23	190	24		CLAYEY SAND: 1, IGHT GREY, NET-								
.0		31		40	190	2º	25	SILTY SMID: GREY, WET, MON-CONESTIVE, FIRE GRALMED SAND, SHELLS-								
	SM			•	100	35	2 9	SAME: MAGANIC-								
0																
	sc	39	39	15	190	45	*1	CLAYEY SAND GREY, MET, FINE GRAINED SAND, SHELLS-								
.0																
5	21_	18		P	100	36_		SILTY SMID: SMEY, MET, OMERATIC-								
0	P/SI	35		MD.	100	6		SMOVSILTY SMO: GREY, HET, ORGANIC:								

TH79-10

DEPTH	1.06	MC	ш	P)	-4	-200	N	DESCRIPTION
	n.	14	29	6	100			SAMOY SILT: LIGHT BROWN, MOIST, FIRM-
3-0		_				-		
							12	CLAY: SAME AS ABOVE-
	α	74	42	21	100	86	••	SAFE: STIFF.
			72	21	100	œ		CHE Company of the co
9.0								SAFE: FREY BROWN WITH RUST, MOIST, FI
							9	SANDY SILT: SAME AS ABOVE-
							9	SAME: GREY, MET, FIRM TO STIFF, INTERIFIES SAND.
		32		Mb.	100	53		FIRE SAND-
14-5								
14:2		_					15	
		39		₩°	100	73		SAME: LIGHT GREY, WET, DENSE-
			_					
	ų							SAFE: FREY, HET, FIRM TO STIFF, SLIGHT
		53		*	100	95	เก	
							17	SAME: SCATTERED SHELL PRAGMENTS, INTERN
		30		¥C	100	88		SHEET SHEET SHEET PRINGERIS, 14150
						~~		
.5	 .						15	
								SILTY SANT: SAME AS ABOVE.
	78	17		*	100	17		
.5								SAME: GREY, MOIST, VERY DENSE, OWELLS PRABMENTS.
.1							66	SAMD: ARRY, MOIST, VERY DENSE-
	9	<i>j</i> :			100	4		The second secon

TH83-2543

					_	10	TH83-25	43			1A /0+	/2 R			€L. 192
ND					<u></u>	179-10	DEPTH	LOS	MC	u	PI	-4	-200	H	DESCRIPTION
ST	92+	00 L				EL. 10±		92						24	SAND: LIGHT BROWN, HEBIUM GRAINED, HOW-COMESIVE-
u	Pl	-1	4	-200	N	DESCRIPTION	3.0							•	
29	6	100	0	56		SAIDY SILT: LIGHT BROWN, MOIST, FIRM-	_2:0		9						SILTY SAND: BROWN, MOIST, NON-CONESIVE.
<u> </u>						OLAY: SAME AS ABOVE-	8.0	SP/SA						12	
					12	SAFE: STIFF.	8.0		10						SAND/SILTY SAND: BROWN TO LIGHT BROWN, FINE TO MEDIUM GRAINED, HON-COHESIVE-
42	21	170	}	%		SAME: GREY BROWN WITH RUST, MOIST, FIRM TO SOFT.		29	8					5	SANT): LIGHT BROWN, FINE GRAINED, NON-COMESIVE-
							12-0							8	SAME: GREY, DRY
,					,	SAMILY STUT: SAME AS ABOVE-	13.5	M.							SILT: RROWN, MDIST, COMESIVE-
*	¥	190		59		SAME: GREY, MET, FIRM TO STIFF, INTERBEDS OF SILT AND FINE SAMO:		СН	37	73	40	100	99		CAY.
							16-5								
					15		18.5	۹.	-Z5 						SILT: BROWN, MOIST, COMESIVE
	I ₽	130		*1		SME: LIGHT GREY, WET, DENSE-					54	100	190		(LAY.
							21.5								SILT: WATER AT 24-9 SEET.
					10	SAME - GREY, MET, FIRM TO STIFF, SUIGHTLY MICAGENIS.	<u>4 24 0</u>	*	35	41	ĬΦ	190	99		DELL MARIES AT SANT PEET-
	₩	170		#			79.5								CILTY SANT.
								24	27		*	100	14		if it Ander
							27.5 28.5	<u>A</u>							SMATE GREY, SATURATED, AT PERCENT SHELL BRADENTS.
					;'	SAME SCATTERED SHELL PRAGMENTS, INTERBEDS OF SILT.	20.0	OI.					===		CLAY: SREY, MOIST-
	MP	ĮX		só		· · · · · · · · · · · · · · · · · · ·		SP/SM	15		% P	199	ıı		SAMO/SILTY SAMO.
					14		11.5		25				_	5.2	SATO: GREY, SATURATED, SHELL FRAGMENTS.
_						SELTY SAMP. CAME AS ABOVE.									
	•	į.v		:•					25					วรุง	
						TAME THEY, MOTIT, VERY DEMSE, SWELLT AND SWELL STADISHTS.			_						
			-		4	TAMO GREY, MOIST, VERY DENSE-			29					72	
		y				many many regression		50							
		•		•					27					56	
					114				~						
									23						
														504	
									24					25	SPE: LARGE SHELLS.

SCALE: I N-3FT

NOTES

- 1. SEE PLATE 25 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE & FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE

SYMBOL	DROSTRONS	\$47E	APPROVAL							
	REVISIONS									
	U. S. ARMY ENG LOS AN CORPS OF E	GELES								
00000-01.	SANTA ANA RIVER MAINSTEM, CALI PHASE II GENERAL DESIGN MEMORI	FORMIA NDUM								
MAWN BY	LOGS OF INVESTIGATION	NS								
į	CORPS OF ENGINEERS									
CONCRED BY										
	STA.86+00 TO STA.76+	72								
SUBMITTED BY.	PATE APPROVED. SPEC. NO. DACWOS.	.	SHIPET							
i	DISTRICT FILE NO.									

TH83-2546

EXIS'	EXISTING GROUND TH83-2546 STA 70+50													
TH83-25	46	٠	8	TA 704	50 L			EL. 10#						
DEPTH	L06	MC	ц	PI	4	-200		DESCRIPTION						
	α	18	12	9	100	81	15	SAMBY CLAY: BROWN HOIST-						
	_		_	·										
3.0	4.	31		NP.	100	82		SAMBY SILT: BROWN, MOIST, NON-COHESIVE.						
9.5														
	α	43	30	15	100	97	5	CLAY: BROWN, MOIST-						
8-0														
		22_		100	100	98		STLT: BROWN, MET, COMESTVE-						
¥ 11.0	M	37		MР	99	65		SMMY SILT: SAME, GREY, WATER AT 11-0 FEET-						
12.0							21							
								SILTY SAMD: GREY, SATURATED, NON-COHESIVE.						
	54	20		MP	100	39	24							
16-0		25		HP.	100	18		SWE: SHELL FRAMENTS-						
17-0	37/31	75			97		37	SWID/SILTY SWID: FREY, SATURATED, SHELL PRABMENTS.						
		26		160	99	- 27		SILTY SAMD: GREY, SATURATED, 2 INCH LENS OF 50 PERCENT SHELL PRAGMENTS.						
	SPI	28		Mb	100	16	36	SAME: NO LENS OF SHELL FRAGMENTS-						
22.0														
							449	SMD: SREY, SATURATED.						
	30	27			100	3	44-							
	-				100	2								
•••					100	-	48							
28.C				_			12	SAND/SILTY SAND. GREY, SATURATED-						
	39/3H	25		*	100	5								
•• •							39							
31-9	99	26			100		9	SARD: GREY, SATURATED.						
33.0							18	SMM/SILTY SMM: GREY, SATURATED						
	SP/SM	26		*	100	5	26							
36.0														
							38	SASTI: GREY, SATURATED-						
		?5			100	*	इर							
							17							
		?:			190	3	57							
						,								
	Ş						21							
		25			100	4	31 56							
							ю							
		24			100	3	13							
		25					35							
1.5		27			120	3	37							

<u>TH79-9</u>

97/SM II NP 100 I2 SAME: LIGHT GMEY, MOIST, DEMSE. 47 CLAY: LIGHT GMEY, MOIST. SAME: BROWN, MOIST. 8.0 18 SAMEY SILT: DANK BROWN, MOIST. 19 SAMEY SILT: DANK BROWN, MOIST.									
SMBUTSILITY SMBD: LIGHT BROWN, MOIST, LOC SP/SM II				\$1	TA 67+	50 R			£1. 8±
97/SM II 8P 100 12 SAME: LIGHT GREY, MOIST, DEMSE. 9.0 CH 57 79 %6 100 96 SAME: BROWN, MOIST. 8.0 10 SILTY SAMO: DARK BROWN, MOIST. SALT: LIGHT GREY, MOIST. SAME: BROWN, MOIST. 28 SAMOY SILT: DARK BROWN, MOIST. SLIGHTLY MOIST. 29 MP 100 73 M	BEPTH	L06	MC	ц	PS	4	-200	*	DESCRIPTION
CLAT: LIGHT GREY, MOIST. SAME: SMOON, MOIST. 18 SAMEY SILT: DANK BROWN, MOIST. 19 SILTY SAMO: DANK GREY, MOIST. SLIGHTLY A SILTY SAMO: DANK GREY, MOIST. SLIGHTLY A 20 MP 100 73 ML		9P/S#	11		6 P	100	12		SAME/SILTY SAME: LIGHT BROWN, MOIST, LOOS SAME: LIGHT GREY, MOIST, DENSE.
8-0 18 SAME: BROWN, MOIST. 18 SAMEY SILT: DANK BROWN, MOIST. 11-0 10 SILTY SAME: BROWN, MOIST. 13-0 10 SILTY SAME: BROWN, MOIST. 13-0 10 SILTY SAME: BROWN, MOIST. 21 SILT: DANK BROWN, MOIST. 22 SAMEY SILT: INTERBEDS OF SILT. 23 AP 130 73 14 28 SILT: DANK GREY, MOIST.	4-0							47	CLAY: LIGHT GREY, MOIST-
13-0 10 SILTY SAND: DANK GREY, MOIST, SLIGHTLY A SH 20 MP 100 28 22 SANDY SILT: INTERMEDIS OF SILT. 28 SILT: DANK GREY, MOIST.	8.0	CH	37	79	46	100	96		SAME: BROWN, MOIST-
13.0 SILTY SAMO: DANK GREY, MOIST, SLIGHTLY M SN 28 MP 100 28 18.0 SAMOY SILT: INTERMEDS OF SILT. 29 MP 100 73 N			.,					18	SANDY SILT: DANK BROWN, MDIST-
10 SILTY SAMO: DAMK GREY, MOIST, SLIGHTLY A SH 28 MP 100 28 22 SAMOY SILT: INTERMEDS OF SILT. 23 MP 100 73 M		n.	ΣĮ		ИP	100	63		
18-0 22 SANDY SILT: INTERMEDS OF SILT. 29 MP 100 73 AL	13-0							10	SILTY SMID: DANK GREY, MOIST, SLIGHTLY MI
M_20:0 22 SAMOY SILT: INTERMEDS OF SILT. 22 29 MP 100 73 73 74 28 SILT: DARK GREY, MOIST.		SM	28		P	100	28		
29 MP 100 73 PL	18-0							27	SANDY SILT: INTERBEDS OF SILT.
28 SILT: DARK GREY, MOIST-	<u> 20.0</u>		29		æ	100	73	и	
_		*	_					28	SILT- BASK GREY, MIST.
			33		*	100	89	20	water a programme of the programme of th
28-0	28.0							16	

TH79-9

IA 67+	50 R			€L· 8#
PI	4	-200	N	DESCRIPTION
WP	100	12		SMID/SILTY SMID: LIGHT BROWN, MOIST, LOOSE- SME: LIGHT GREY, MOIST, DEMSE-
46	100	96	47	CLAY: LIGHT GREY, MOIST-
	100	63	18	SMBY SILT: DANK BROWN, MOIST-
MP	100	28	10	SILTY SAMD: DAMK GREY, MOJST, SLIGHTLY MICAGEOUS-
HP.	100	73	22	SAMOY SILT: INTEMBEDS OF SILT-
	100	89	29	SILT: DAWK GREY, MOIST-
			16	

TH 79-8

9-8			\$1	A 57+5	10 L			EL. 10±
TH	L06	MC	ш	PI	-4	-200	N	DESCRIPTION
								QLAY: LIGHT BROWN, MOIST, SOFT-
	CH	25	62	33	100	86		
<u>a</u>							5	
	_						,	SANDY CLAY: SREY BROWN WITH MUST, MOIST, SOFT-
	a.	45	4/	28	100	52		
0								
1-0							5	SAND/SILTY SAND: GREY, WET, MANY SHELL PRAGMENTS-
	SP/SA	25		NP	100	8	9	
0		_					33	SILTY SAND: GREY, WET, DENSE-
	SM	26		н₽	100	14		
.0							53	SAND/SILTY SAND: GREY, MET, YERY DENSE.
		23		ND.	100	7	•	
		0		•	100	,		
	SP/SA						72	SAME: GREY, MET, MEDIUM DENSE, SHELL FRAGMENTS.
		24		ıφ	100	12		
								SAME: DENSE-
.0								SILTY SAND: GREY, MET, DENSE, SHELL FRAGHENTS.
							36	
	SM	21		₩	100	17		
).Q								
							56	

SCALE: I M=3FT

NOTES:

- I SEE PLATE 25 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2. SEE PLATE SA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE & FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
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SYMBOL	DESCRIPTIONS		DATE	APPROV						
	REVI	SIONS								
		U. S. ARMY ENGIN LOS ANG CORPS OF EN	ELES	ict						
CHENCHED BY.		RIVER MAINSTEM, CALIF NERAL DESIGN MEMORAN								
BAWN IV.	LOGS	OF INVESTIGATION	4S							
	CORPS OF ENGINEERS									
GROUP IN	STA.70)+50 TO STA.67+5	0							
PLEMITTED BY,	DATE	500 MO 040000		Settl						

Ele. 5.2'

0.65

083 c 50]

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050 059

121

114

water table in sore

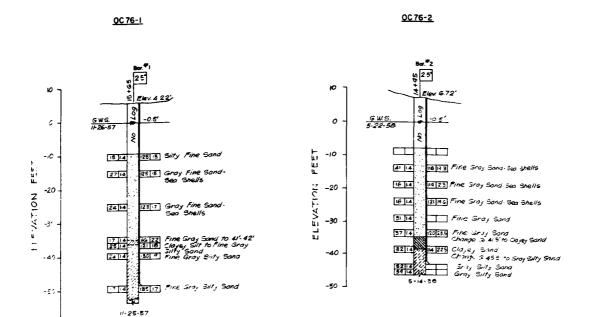
-10

⊢ ₪ 11 -20 ₪

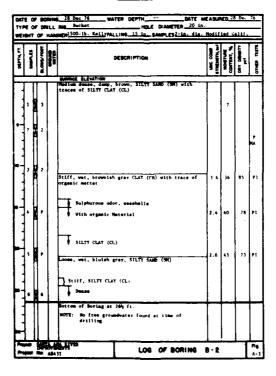
-30

-70 i

VATION



WC 77-2



NOTES

- I SEE PLATE 25 FOR TES
- 2. SEE TABLES 4 AND 5 FROM WHICH THESE LOGS AND EXPLANATIONS ARE CO
- 3. LOGS BY OTHERS ARE OF DETERMINE THE GENERAL

Sana-Seo shells

y Sond 4.5' to Clayey Sond

100 455 to Snay Sity Sno.3 ty Sond ty Sond

r. Sund

<u>0076-3</u>

Elev 5.2' 0 7-3-57 Compact silty sand -10 0.85 21 14 Compact si sulty sand+shells 는 1) 보 -20 -089[20]14 | 182|30 | Compact Sity sand | 186|21 | Sense Slear fine sand 0.50 20 14 NCITAVE-0.18 48 14 water table | 46|14 | 15 :majer | 45|14 Dense clean coarse sond+shells St. 4 clay derse with some pent 050 3 4 Sil confloct silty sond 1211714 7-3-57

<u>0076-4</u> Ю Elev 3,1" GWS ELev-2.3'

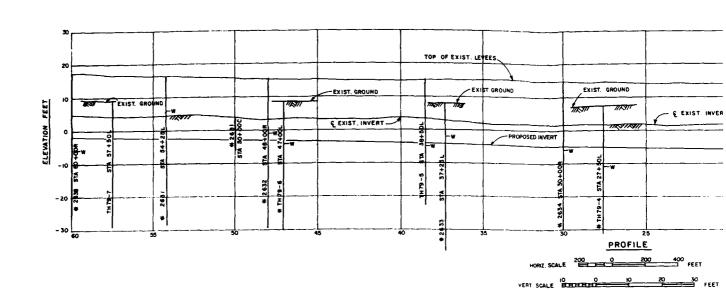
Compact black fine suity sund -10 052 0 1A FEET Hard 01124 5/14 2/3 -20 U2 |58 4 ELEVATION 114 48 . 4 -30 081 61 14 -40 219 42 14 Attention of the second ET:Ta

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NOTES

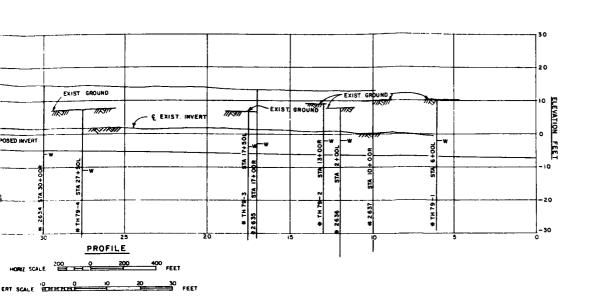
- SEE PLATE 25 FOR TEST SITE LOCATIONS
- 2 SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WERE TAKEN. ALL LEGENDS AND EXPLANATIONS ARE CONTAINED WITHIN THE REPORTS
- 3 LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE

STMBOL	DESCRIPTIONS	DATE	APPROVAL						
	REVISIONS		1						
	LOS	NGMEER DISTR ANGELES OF ENGINEERS	icī						
DESIGNED SY.	SANTA ANA RIVER MAINSTEM, C PHASE II GENERAL DESIGN MEM								
CEAWN SV.	LOGS OF INVESTIGAT	TION							
	BY OTHERS								
CHECKED BY.	STA.130+00 TO STA.80+0								
PARTIED BY:	DATE		SHEET						













NOTES:

- I. SEE PLATE 8 FOR LEGEND AND GENERAL NOTES.
- 2. SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER SERIES FOR LOGS OF INVESTIGATIONS.

DATUM	IS NATIONAL GEODETIC	C VERTICAL DATUM	OF 1929					
STHECK	MICHITAL INC.		BATE	APPROV				
	REVIS	IONS						
		U. S. ARMY BNGS LOS AND CORPS OF BY	e.es	G				
******		TIVER MAINSTEM, CALIF ERAL DESIGN MEMORAN						
Shawer St.	PLAN AND	PROFILE						
00000 PA	STA.60+00 TC	STA.0+00						
RAMPIED BY:	DATE	SPIC. NO. PACWOP.		20427				
		DISTRET FILE NO.		1				

						IH	83 - 1	2638 ճ. ւ 17ե										
7#3-263V	ı		5	TA 60+0	NG R										1	<u>H</u> 7	9-1	L
EPTH	L06	MC	u	Pĵ	4	-200	H	Description	<u>EXIS</u> 1109-7	TING	GR		_	-				FI. 19#
		.,	34	14	100	47		CLAYET SAND: BROWN, MOIST, MON-COMESTIVE, 2 INCH LENS OF SILT-					TA 57•					DESCRIPTION
	æ	12	*	14	100	•	44		DEPTH	L06	MC .	ш	Pl	-4	-200		-	
3-0		15		*	100	55	"	SMOY SILT: PROM, MOIST, MON-C'MESIVE.		SM	9			100	37			SILTY SAMD: ORANGE-BROWN, MOIST, METH GRAMEL TO 3/4 INCH-
5.0								SILTY SAMD: LIGHT BROWN, MOIST, NON-CONESIVE, PERILUH TO	2:0		35			100	73	-		SMOY SILT: GREY-MATHIN HETH RUST, HITE
		3		M	100	15	8	FINE GRAINED SAND	4.0	MH	-"			100			3	CAMEN / SILTY SAMEN: GREY, MOIST, SOFT TO
	SM																	MICACEGUS, SHALL ROOTS.
		6		₩.	100	35	2			59/54	35		40	190	11			
		-																
11.0		32		MP.	100	91	3	SILT: BACK MICHAL, MOIST, COMESIVE, ORGANIC MATERIAL.	9.0							_	5	SILTY SAND: GREY, MOIST, SOFT TO FIRM
		52		•	Like	•					19		197	190	ı	6	,	
		-					- 5							100	•	_		
									WILE_C		_					_		
W 17.5									•								24	SAME: GREY, MET, MEDJIM DENSE, SHELL 2 INCH LENS SILT, BROWN, MET, SOFT.
		39		100	170	97					23		•	100	, ,	5		SAME: FIREY, MOIST, MEDIUM DENSE, SM
	1																	FRACHENTS-
											_					_	23	
		-					-	SANDY SILT: GREY, MET, MON-COMESTVE, MEDIUM TO FINE										
		3	•	ΨP	190	70	5	GRAINS, SOME SHELL PRASMENTS.			18		,	P 19	, ;	26		
		_					_											
		2	3	₩.	100	55	4			\$1	-					_		
21-0							_				5.	,		P (1	n	16	33	
								SILTY SAND: GREY, WET, FINE GRAINED SAND, SHELL SANDREY.			э.	4		, ,				
	34	4	1	4	33	3	3											
											_						29	SAME: WET, MEDIUM NEWS TO THEMSE.
33:2 34:0	975	7 7	5		9	7	.	SAMM/STILLY SAMD: THEY, NET, FINE GRAINED SAMD, SHELL PROPERTY.							~	21		
23_			.4		12	,	4 20	SAND: SHEY, HET, NON-COMPSIVE, MEDIUM GRAINED SAND-			2	5		¥P !!	.N	21		
		•			• "												23	
	9						_	SME: SHELL FRABMENTS.										
			85		19		4	•										
40.S			74		7 7 TO		र र	CHINAST TO SAME, GREV, SATURATED, METEUM CRAIMED SAMES.										
	39 7	Ç# .					ı		39.	Q			•					
45.0			20 ———		P 3		_										34	
	3	n	虭	•	to IJ	n 1	.3	CILTY SAME: GREY, SATURATED, FINE GRAINED SAMED										

TT84 - 2681

1794-2581			\$1	A 50+0	n c			£L. 42			
EPTH	L06	-MC	u	Pf	-4	-200	H	DESCRIPTION			
	9				ເກ	1		SAND: PLULTI-COLPR. WET, MEDIUM GRAINED SAND-			
3.0	۹.		₩,	15	100	η		SILT: TANK THOM WITH REDDISH BROWN PARTICLES, MET, CHESTVE.			
5.0			57	. 40	100	80		SAMIY (LAY: LIGHT GREY, WET, CONESIVE-			
	CH	***	54	85	100	70		CLAY: THE BROWN WITH RESIDESH BROWN PROFICUES, NET, CONESIVE.			
10-0											

<u>TH79-7</u>

		€L- 10±
-200	,	DESCRIPTION
r		SILTY SAMT: ORANGE-BROWN, MOIST, MEDIUM DERNE, SOME GRAVEL TO \$/4 INCH-
73		SMBY SILT: GREY-BROWN WITH BUST, MOIST, SOFT-
!!	7	SMB/SILTY SMIT: GREY, MOIST, SOFT TO FIRM, SLIGHTLY MICAGEOUS. SMALL GOOTS-
15	ς	SILTY SMITH: SREY, MOIST, SOFT TO FEMM, SLIGHTLY MICACEOUS-
	74	SAME GREY, WET, MEDITAL DENSE, SHELL FRASMENTS AT 15 FEET, 7 THAN LEWS SILT, SHOWN, WET, SOFT-
	25	SAME. FAREY, MOIST, MEDIUM DEHSE, SMELLS AMD SHELL ORACHBUTS.
26	-	
16	11	
	79	ीचें का, का ाम क्सर का क्सर .
27		
	**	
	15 15 25 26 16 16	P

TH83-2631

EXISTING		GR				1115		<u> 21.</u>		
THB3-26	31		S1	A 54+7	25 L			EL- 17±		
DEPTH	F00	NC.	LL.	P[-4	-200	N	DESCRIPTION		
	11,	25		МP	100	જ		SILT: LIGHT BROWN, MOIST, MON-COMESIVE-		
3.0							18	Clay		
	CH	'r)	50	24	190	99		CLAY: BROWN, MOIST, VERY FINE MATERIAL, COMESIVE-		
6.0	1	47		NP	100	33		STLT: Drawn, Maist, COMESTVE-		
3.5	: L			re	100					
		5		No	199	41		SILTY SAMD: SHEY, HEDIUM GRAIN, MOIST, NON-COMESIVE, SOM SHELL FRAGMENTS.		
11.0	211	29		:IP	94	56	11	SAME: GREY, SATURATED, MEDIUM GRAIN, NON-COMESIVE,		
3.0								2) PERCENT SHELL FRAGMENTS.		
		19		YP.	90	15	?5	SAND/SILTY SAND: GREY, SATURATED, MEDIUM TO COARSE GRAINED, MON-COMESIVE, 40 PERCENT SHELL FRAGMENTS-		
		20		ų,	96	50				
	\$P/\$f1	_					43			
				יאי	35		٠,			
		?u		· Po	*	12				
2.5	5₽/SC	25	81	1.7	130	11		SAND/CLAYSY SANT: GREY, SATURATED, MEDIUM TO FINE GRAIN-		
4.0	gr 5 3	27		T	34		43	SAID/SILTY SARU: GREY, SATURATED, MEDIUM GRAIN, SOME SHELL FRAGMENTS.		
		.77		¥	127	15		SILTY SWD: GNEY, SATURATED, MEDIUS GRAINED, FEW SHELL FRASHENTS.		
	83	25		φ	189	;-				
							35.2			
		27		*90	1.	.*	y			
er a		27				•				
35.4		71		 F				STUDITION SATINATES, HERCUS TO FINE GRAINES NON-COMESSIVE.		
		'*		·	•		•	AN COLUMN		
				-1	rı	11	4:	SATE: GREY, SATURATED, MEDIUM TO FINE GRAIN, NON-COMESTIN		
				•	•.	4.	•	LIN THEFT LINE ENIS.		
	25V21							SATE: Few SHELLS.		
		13		52	:\		Ţ)			
				<u> </u>						
		3		₩ ⊃	199	•				
)										



NOTES

- I SEE PLATE 26 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2. SEE PLATE 84 FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE

SYMBOL	PRICH/TICHS		DAW	MPROVA							
	REVIS	IONS									
		U. E. ARMY ENGIN LOS ANG CORPS OF EN	eles	a							
DESIGNATION SYL	santa ana river mainstem, california Phase II general design memorandum										
	LOGS OF INVESTIGATIONS										
DEATH IN	CORPS OF ENGINEERS										
CHECKED BY	STA.60+00 TO STA.50+00										
SUBMITTED BY:	DATE	SPEC. NO. DACWOP		SHEET							
		DISTRICT FILE NO.									

TH83-2632

THB3-;	7HB3-2632		51	TA 48	+00 R			£. 16t	
DEPTH	£06	ж	ц	PĮ	4	-200	N	DESCRIPTION	
		9		ИР	99	20		SILTY SAND: BROWN TO LIGHT BROWN, MOIST, MON-CONESIVE	EXISTI
	58	12		•	95	35	23	SAFE: Birn, MOIST, FON GRAVEL TO 3/4 INCHES, MON-CONESTVE.	DEPTH
		12		1P	100	34	19	SAVE: THROWN, MOIST, MON-COMESIVE	4-0
9.0							9		
10.5	20/41	4		100	100	12		SAMP/SELTY SAMD: LIGHT BROWN, MOIST, NON-COMESTVE	
11.5	ď	29	42	23	97		5	SARTY CLAY: BROWN, MOIST-	
19-0	SM	19 21		₩	700 700	44		SILTY SAMD: LIGHT GREY, MOIST, FINE GRAINED, NON-COMESTVE. SAME: GREY AND BROWN.	
	4	44		*	100	93	18	SILT: BANK GREY, MOIST, COMESIVE.	
₩ 1.7-0									<u>H 13-0</u> 14-0
20 <u>.û</u>				₩	95	48	5	SILTY SMID. SREY, MET, FINE GRAIN, MON-CONESIVE, SOME	9
	5*	19		IP	33	14	35	SMELL FRAMEWITS: SILTY GRANCLY SANO: GREY, NET, FINE TO MEDIUM GRAIN, NON-CONSTITE, SOME SHELL "RAMMENTS."	19.0
25.0	æ	3			98	4	23	SWID: SREY, NET, MEDIUM GRAINED, NON-CONESIVE, SOME SHELL PRAGMENTS.	
		25		۳	110	5		SAMD/SILTY SAMD: GREY, MET, FINE GRAINED SAMD, NOT-CHESIVE, SOME SHELL FRAMENTS.	29-0
		21		MD.	93	,	29	SATE: FIREY, SATURATED, MEDIUM GRAIM, MON-COMESTVE, AD PRECENT SHELL PRABMENTS.	S 20 0
	SP/54	23		* P	100	,	47	CAME: GREY, SATURATED, MEDIUM TO FINE GRAIN, NON-COMESIVE.	29-0
		27		*	100	6	24		
							13		
41.0		29		₩	190	5			
	P	30			100	4		SMIN: SPEY, SATURATED, FINE TO "EDILUH SPALINED, NON- COMESIME:	39.0
95.)									

TH79-6

EXIS TH79-6			s	TA 47-	Λ0 F			FL 9±
DEPTH	L06	MC	u	PĮ	4	-200	N	DESCRIPTION
	СН	36	53	26	100	96		CLAY: BROWN, MOIST, SOFT TO FIRM.
4-0							5	SILTY SAND: BROWN, MOIST, COOSE-
		37		4 P	190	10		
	SM			p	100	13	3	SAME: FREY, MEY, LOOSE, ROOTS TO 11 FEE
W 13-0 14-0								SAME: GREEN-BROWN, NET, SOFT-
	59/5M	20		₩	109	12	29	SAND/SILTY SAND: GREY, MET, DENSE, SHEL:
19.0	SM	20		Ψ	100	19	31	SILTY SAMO: FORTY, WET, TENSE, SHELL FOR
29-0	5P/5N	21		Ψ,	107	12		SAMP/SILTY SAMD: RMEY, WET, DENISE, SHE
9-0				4 c	100	16	65	SILTY SAND: SAREY, WET, VERY DENICE, SHEU
	ÇM	w= v		***				S. M. C. C. C. C. C. C. C. C. C. C. C. C. C.
		2:		₩	100	14		SAME: FREY, MET, DENSE, SHPLUS AND S.E.
9:1							77	

TH79-5 FL . 15\$ STA 38+508 TH79-6 DESCRIPTION DEPTH LOG MC 11 PI -4 -200 M SAMDY CLAY: BROWN, MOIST, STIFF-TA 47+10 FH 43 62 35 100 77 15 SMF: 1 IGHT BROWN, HOIST-SAFE: LIGHT BROWN WITH RUST, MOIST-SILTY SMITH ROOM, MOIST, LOOSE-SANDY SILT: GREY BROWN WITH RUST, MOIST, SOFT-ML 40 48 20 100 89 13-0 COME. SHEY MET, LADSE, ROOTS TO 11 FEET-SILTY SAND: GREY, MOIST, MEDIUM MENSE-34 29 ₩ 100 21 144 REEN-BROWN, HET, SOFT-BY TO ITY SAND SREY, HET, DENSE, SHELL PRAGMENTS. 18-0 SAND/SILTY SAND: FREY, MEDIUM DENSE, MOIST. £ 19.5 Ψ 1° 1° SAME: HET, SHELL FRAGMENTS. 7 ¥P 100 SAME: GREY, MET, MEDIUM DENSE TO DENSE, MANY SHELL REAGMENTS. MP 100 19 28 - 3 **v** ∂ 2 \$6 46/95 ₩P 100

TH79-5

₩ 100 10

NOTES:

ME HARY, WIT, NENSE, SHELLS MAD SHELL FRAGRENTS.

- I SEE PLATE 26 FOR LOCATION OF TEST HOLES AND TEST
- 2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED
- 4 ALL TEST HOLES AND TREMCHES WERE SET IP ON THE LEVEE CREST UNLESS OTHERWISE NOTEO AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE

SCALE: I N. SFT

DESCRIPTIONS	0476	AFFROYAL							
REVI	SIONS								
	U. S. ARMY ENGINEER DIS LOS ANGELES CORPS OF ENGINEER								
SANTA ANA RIVER MAINSTEM CALIFORNIA PHASE II GEMERAL DESIGN MEMORANDUM									
LOGS OF INVESTIGATIONS									
CORPS OF ENGINEERS									
STA.484	STA.48+00 TO STA.38+50								
DATE	SPEC. NO. DACWO9 B	\$1000							
	DISTRICT FILE NO	1							
	SANTA ANA PHASE II GE LOGS (CORP STA,484	REVISIONS U.S. ARMY ENGINEER DE LOS ANGELES CORPS OF ENGINEER SE CORPS OF ENGINEER SANTA ANA RIVER MAINSTEM CALIFORNIA PHASE II OPMERA DESIGN MEMORANDUM LOGS OF INVESTIGATIONS CORPS OF ENGINEERS STA.48+00 TO STA.38+50 DATE APPROVED. SPEC. NO. DACW 09							

83- 2	-2633 STA 37+25 L				FF Az			
PTH	L06	MC	_u	PĮ	4	-200	M	DESCRIPTION
_	a.	10	22	13	100	56		SANDY CLAY: BROWN, MOIST, MEDIUM TO FINE GRAIM, NON-COMESTVE-
2.5	SM	10		MP.	100	31	15	SILTY SAND: LIGHT BROWN, MOIST, FINE GRAIN, NON-COME
4.5					_		14	
7.Q	СН	48	59	30	100	94		CLAY: BROWN, MOIST, COMESIVE-
		27		IP	100	52	5	SILTY SARD: LIGHT BROWN TO GREY, MOIST, FINE GRAIN, CONESIVE, SOME SHELL FRAGHENTS.
V 10 5	SM 9	23		NР	97	14	17	SAME: GREY, MOIST, MEDIUM TO FINE GRAIN, NON-COMESTY SOME SHELL PRAGMENTS.
3.0							₹6	SAND/SILTY SAND: GREY, MEDIUM GRAIN, HOIST, NON-COME
	50/54	22		40	100	5	53	2 and to 15 in 2 and 1. week, we find a paint to be 121' would crees
6-5							18	
	29	20			100	?	75 42	SAND: GREY, SATURATED, "EDILIPA TO CHARSE GRAIN, NON- CHARSIVE-
2-1	SP/SM	22		Yp	190	5	₹0	SAND/SILTY SAND: SREY, SATURATED, MEDIUM GRAIMED-
<u>5.u</u>	ъ.	25			99	•	6 24 32	SMID: GREY, SATURATED, METHUM GRAINETI-
7.3	50/5 4	23		*	107	τ,	38 34	SMM/STLTY SMM: SREY, SATURATED, HEDITH GRAINED-
0.0							19	FMD Community
		23			199	4	34	SAMM: SREY, SATURATED, MEDIUM GRAINED-
	2º	?7			เวอ	4	59 50	
16.J						<u>-</u>		
	SP/17#	24		¥0	1:00	5	46	SAMD/SILTY SAMT: GREY, SATURATED, MEDI:M GRAINED, FEW SMMLL MACHINES.
9.1		r)		₩.	;nn		ţn	SILTY SMM: GREY, SATUPATEN, FINE GRAIN, NOW-COMESTAY FRA DELL PRADMENTS.
	39				10°			SAME: TRANCGREY, SATURATES, HON-COMESTYE, ORGANIC-
ıs.a								

TH83-2633

TH83-2634

TH83-2634			\$1	A 30+	00 R			EL - 15±
DEPTH	L06	MC	ш	P1	-4	-200	N	Description
		13	23	5	87	34	17	CLAYEY SAMD: BROWN, MOIST, GRAINON-COMESIVE.
	sc	15	24	5	100	24	9	SATE: BROWN, MOIST, FIME GRAIN
		14	79	11	100	35	10	
10.0		12	52	13	100	69		PLAY: LIGHT BROWN, MOIST, FINE SME: BROWN, MOIST, VERY FINE:
	:L	 26	30	9	100	<u>93</u>		SAPE: PROMY, HOIST, VERY FINE S
13.5	SII.	. 25		NC	100			SILTY SMO: RED TO LIGHT BROWN
15.5	α	46	¥6	14	100	75		SANTY CLAY: GREY, MOIST, VERY COMESIVENESS, ORGANIC-
	20			₩.	100	3		SANT): FREY, MOTST-
18.0							14	SU DY CAND. Beau copy .ex cu
¥ 20-0		52	38	12	100	31	23	SILTY SAND: TARK GREY, NET, FI CONESIVE, ORGANIC, SOME SHELL F
	SH	78		4c	190	19		SAME: GREY, MET, FINE GRAIN, N PRAGMENTS.
24-0							19	
	SP/94	24		¥¢	fut	ş		SMIDINGLEY SMID: SREY, WET, WE
27.2	ЗР 	*5			100	3	11	SMD: SREY, WET-
30.0							34	4-14
	5P/SM			Y C	100	5		SAMB/STUTY SAMD: GREY, HEY, HE
33.0							25R	
	₹	?4			193	3		SMID: GREY, WET, NON-CONESTVE-
36 · C				·-·-			רז	
¥.5	⊕/ Ç#	24		40	100	5	15	SMINSILTY SMIT: SREY, HET.
nd for		22			37	,	12	SMID: ARSY, WET, MEDIUM SPAIN, PRASMENTS:
	SP						11	
		,,			100	3	18	
45.0								

TH83-2634

	8	TA 30+	90 R		EL- 15±									
5 1	LL	PI	-4	-200	н	DESCRIPTION								
	23	5	37	34	17	CLAYEY SAMD: BROWN, MOIST, GRAVEL 3/4 INCHES MAKIMUN, MON-CONESIVE-								
	2	5	170	29	9	SAFE: BROWN, MOIST, FINE GRAINED, MON-COHESTYE-								
1	.79	11	100	75	10									
1	37	13	(gr	-59		TIV- LIGHT BROWN, MOIST, FINE GRAIN, NON-COMESIVE								
ł			100	35		SAYE: BROWN, MOIST, VERY FINE MATERIAL, COMESIVE:								
Ì	130	9	190	54		SAME: PET-BROWN, MOIST, FINE GRAIN W/ SOME COMESIVE CLODS.								
4	7.	*	(30)			STITY SMITE. RED TO LIGHT BROWN. FINE GRAIN, HON-COMESIVE.								
	<u>ئ</u> د	14	130	75		SAMMY (LAY: GREY, MOIST, VERY FINE MATERIAL, SOME COMESIVENESS, ORGANIC-								
1		₩P	100	3	14	SANT. SREY, MOTSY-								
	ч	12	135	*I	21	TILTY SMITE THAPK GREY, MET, FINE TO VERY FINE MATERIAL, CONSTITUT, ORGANIC, STITE SHELL PRACHENTS:								
	ř	¥0	131	:1		SAFE SHEY, MET, FINE GRAIN, MONTCOMESIVE, SOME SHELL PRACHEMYS.								
		₩	; 7 0	:	13	SAMP SET SAMP: SPEY, MET, MOTIUM SRAIM, MOMEOMESTIVE								
	****	-	100	;	::	₩° legw, wer.								
		₩	1,0)	5	ě.	SMINSS TY SMIN - FREY, MET, MEDIUM GRAINED-								
			108		25#	'MA': 'GREY, KET, MON-COMESTVE-								
		w p	LY.	 :	**	CMPT/STI_TY SMET - GREY, WET.								
			17		;*	"M" (PCY, 4E", NEDIUM COAIN, NON-CONESIVE, SOME SHELL COAD-ENTS.								
ŀ					::									
1			\mathcal{A}_{ℓ}	•	₹\$									
			-											

TH79-4

DEPTH	L06	MC	ш	PI	4	-200		DESCRIPTION
	SM	17		MP.	100	29		SILTY SAND: LIGHT BROWN, MOIST, MEDIUM DENSE-
2.0		31	78	8	100	87		
4.0	M.	28	40	8	100	85		SAMBY SILT: BLACK AND VERY DARK GREY, MOIST, SOFT, HIGHL ORGANIC, SLIGHTLY MALCODOROUS.
								SILTY SMID: SAME AS ABOVE.
		22		Ψ	100		10	Sign of the same
		u		•	100	30		SAME: GREY, MOIST, MEDIUM DENSE, MANY SHELL FRAGMENTS.
	SM							
	3FI	_						
							20	
		14		₩P	110	15		
								SAME: GREY, MOTST, MEDIUM DENSE-
14.0								SAND: GREY, MOIST, DENSE-
	_							SMIO: GREY, MUIST, BERSE-
	29	24			100	3	32	
₩ 18-5								
19.0								SAND/SILTY SAND: GREY, WET, DENSE-
								SHIP SHIP. SHIP. SHEY, WELL, DEPISE-
		26		₩	190	9		
							24	
	SP/SM	18		φ	190	9		
		22		*	100	8	22	
<u> 4-0</u>								CMA. Copy of annual poor can a
								SAMP: GREY, HET, HEDITUM DENSE, SHELL PRACHENTS-
	26	24			100	3		

NOTES:

- 1. SEE PLATE 26 FOR LOCATION OF TEST HOLES AND TEST TRENCHES.
- 2 SEE PLATE SA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE & FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST MOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVIE.

SCALE: I N- 3 FT

	_									
244C/	CENCEPTIONS.	DATE APPROVAL								
	REVISIONS									
	LOS	INGINEER DISTRICT ANGELES OF ENGINEERS								
DESIGNAD BY.	SANTA ANA RIVER MAINSTEM, C PHASE II GENERAL DESIGN MEM									
PRAWN ST.	LOGS OF INVESTIGATIONS									
	CORPS OF ENGINEERS									
OSCIED BY	STA.37+25 TO STA.2	37+25 TO STA.27+50								
SUBMITTED BY:	APPROVED, SPEC. HO. DACW	09 B								

TH83-2635

							_		71663-2	THB3-2635			STA 17+00 R				Q. 132
		CD0	ROUND				TH	<u>79–3</u>	DEPTH	106	r(C	LL.	LL of -	-4	-200	,	DESCRIPTION
EXIS 11079-3		GRU		A 17+	50 L			£L. 7t						~		25	SAMT: TANK BROWN, FINE GRAINED-
DEPTH	L06	MC	ш	Pl	4	-200	*	DESCRIPTION		20	14			92	3	-6	
1.0								FILL: SILTY FINE SAND, LIGHT BROWN, DAMP, LOOSE-	3.5								
	a	29	44	21	Loa	93		CLAY: BLACK MED VERY DARK CLIVE GREEN, MOIST, SOFT, HIGHLY GREANIC, SLIGHTLY NALOBORDUS.			9		₩	99	18	39	SILTY SAND: LIGHT BROWN, MOIST, FIN CORRSIVE-
9.0								SAMP/SILTY SAMP: SAMP-BROWN WITH RUST, MOIST, SOFT-			12			100	16		
	SP/SM	21		₩.	190	10					_		NP.	100	27	42	
	. ,							SAME: GREY, MOIST, MEDIUM DENSE, SHELL FRABMENTS:		SM	13		₩	100	37		SME; DARK GREY, MOIST, FIRE GRAINE
9-n								SAND: GREY, MOIST, MEDIUM DEMSE, SHELL FRAGMENTS.			~					248	
10.5	90	23			100	4	22				13		₩0	190	17		
	•	.,			•••	•		SAME: NET-	W.15.0		_		-,			13	
9.0								Serve: me 1	<i>V.</i> 0		20		M C	100	13		
							36	SAND/SILTY SAND: GREY, WET, DENISE-	19-0	SP/SH	25		4	100	6		SAND/SILTY SAND: GREY, MET, FIME GR
		24		NP	100	7			ACX	591	30		₩P	96	13	25	STUTY SMID: LIGHT GREY-BROKE, ME".
		_							2.3		77			100	 - 	5	
							53				_					_	SAND: LIGHT GREY, HET, FINE TO MEDI
		25		*	7.00	5				Ф	24			190	4	28	
								SAMD/SILTY SAMM: SAME AS ARROYE-	11.5								
	99/54	10			100	5	35	SAME STATES		20124	27		φ	36	5	5	SAMIN/STETY SAMIN: TUGHT GREY, FINC T
		•-							30.5								
																	SMM: LIGHT GREY, MEDIUM GRAINED, 51
							54	SATE: GREY, WET, DENSE, SHELLS, GRAVEL TO 1/2 IMON-			ν			97	2		
		23		φ	100	7										26	
											10			97	?		
		72						SAFF: LENS OF RUST AND BLACK		82						26	
		*2		₩	I''U	5	52				22			06J	2		
								SAME: GREY, WET-			18		Ψ	100	4		
9:0																35	
							52				19		10	100	2		
									45.0							25	

LUE ENGINEERING PAYS

TH83-2635

7+00 R				£L. 13±									
1 -4		200	1	DESCRIPTION	EXIST	ING.	CROI	MID.				<u>TH79-2</u>	
			76	SAMT: TRAPK BROWN, FINE GRAINED-	TH79-2			STA	13400 (ł			EL. 92
32	?	3			MEPTH	L06	MC	LL I	Pt	-4 -2	00	4	DESCRIPTION
×,	,	13	† 9	SILTY CAND: LIGHT BROWN, MOIST, FINE GRAINED, MON- COMESI .		SH	13	1	P 10	00	46	SILTY SAM	D: FINE, LIGHT BROWN, MEDIUM DENSE-
: 10		15			4-0							21 ——	
x		- 27"	42									CMUNCILLI	I SAND: THANK GRAY-BADAN, MOIST-
įγ		21	•••	SAME: DARK GREY, MOIST, FINE GRAINED, NON-CONESTIVE-		SP/S#	23	1	P 10	00	г		
			5 00		9.0							SAME: GRE	EY, MOIST, MEDIUM DENSE.
; w		:*			¥ 10.5							SAND: GRE	EY, MOIST, MEDIUM DENSE.
			!3				18		10	0	4		
100				SAND/SILTY SAND: SHEY, MET. FIME GRAIMED.									
*			15	SILTY SMO: LIGHT GREY-BROWN, MET, FINE GRAINED NON- COLESIVE.					-		1	, SAME: GRE	EY, MET, DENSE, SHELL ARAGMENTS.
			ė			99	57		10	9	5		
		·	ē	SAMD LIGHT GREY, WET, FINE TO MEDIUM GRAINED.							2	\$	
1,10		•	28										
											s	SAME: VER 2 PRAGMENTS:	N DENSE, SRAVEL TO 1/2 INCH. MANY SHELL
¥		4	£	CANT/STUTY SAND: 1 IGHT GREY, FINE TO MEDIUM GRAIMED.									
					28-0								Y, WET, VERY DENSE-
٠.		2		SMO LIGHT GREY, MEDIAN GRAINED, STRE GRAVEL TO 1/2 INCH.							_		SAYN: SREY, WET, DENSE-
			*		,	P/ ? 4	13	٠	100		,		
1.					53.0								
	-		3 6		53.0						- 3:	SAND: SRE	Y, WET, TENSE-
.1'						3 P	20		199		4		
											37	!	
		•	15										
					39.5						- x		
٠,			52								×	•	

MOTES

- 1. SEE PLATE 26 FOR LOCATION OF TEST HOLES AND TEST TRENCHES
- 2. SEE PLATE SA FOR LESEND AND CLASSIFICATION SYSTEM
- 3 SEE TABLE & FOR DATE DRILLED OR EXCAMITED AND TYPE OF EQUIPMENT USED.
- 4 ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE NOTED AS "INVERT" IN THE CHANNEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.

SCALE: I RI-SFT

SYMBOL	Michigan	<u>, </u>	DATE	APPROVAL
	REVI	SIONS		
		U. S. ARMY ENGINE LOS ANGE CORPS OF ENG	LES	7
DESIGNATION BY,	santa ana Phase II Ge	RIVER MAINSTEM, CALIFO NERAL DESIGN MEMORAND	RINIA IUM	
GEAWN ST.	LOGS	OF INVESTIGATIONS	3	
_ }	CORP	S OF ENGINEERS		
CHICARD SI	STA,17-	+50 TO STA.13+00)	
SUBMITTED BY:	DATE APPROVED	SPEC. NO. BACWOP-		SHORT
		DISTRICT PLE NO.		

VALUE ENGINEERING

EXIST		GR				IH	83-	<u>2636.</u> g. 8±	<u>EXIS</u> TH83-2		ĢF		<u>D</u> TA 1000	rc A	<u>1H</u>	33-	2637 EL. 100
WB3-263				TA 12*				Description	DEPTH	L06	MC	LL	Pí	-4	-200		DESCRIPTION
DEPTH	(.06		ш 	PI		-200 		SMIT SILT: BROWN, MOIST, FINE GRAINED, MON-CONESIVE.		SM	,		æ	81	15		SILTY GRAVELLY SAND: BROWN, MOIST, N
	ĸ.	20		# ·	100		15		25							12	SMID: LIGHT BROWN, MOIST, NON-COREST
		21,		MP	1/10	81	5				4	•		99	4		 -
5.5 6.0	3	\equiv	\equiv	-	-18			SILTY SADE BROWN, POIST, NON-CONFSIVE			-					8	
		59		WP	100	89		SILT: GREY, MOIST, COMESIVE, ORGANIC SMELL.			4			99	3		
	A.	36			100	62		SAMOY SILT: GREY, WEY, FINE TO MEDIUM GRAINED, NON- COMESIVE-			-					6	
¥ 10-0											12	!		96	2		
12-0		57		*	סניז	43		SILT: SAME AS AROVE, COMESIVE- SMIN/SILTY SMID: SREY, MET, MEDIUM TO COARSE GRAINED.								15	SAME: LIGHT BROWN, WET, NON-CONESIVE GRAINED SAME-
	SP/\$M	18		炉	93	7		MINSIL'T SMU: MEY, WI, MINOR OF THE SMALL	<u>W 11</u>	ō							
15-0								SILT: GREY, MET, COMESIME.								16	
17-0	181 	58	59		100	98		310. 66.7 6.7 6.7						100	1	10	
		25			100	3		SMID: GREY, MET, COURSE GRAINED.									
											2			100	2		
											-			100	4		SAME: GREY, WET, NON-CONESTYE, MEDIT
											-						FRAGMENTS-
		_								20	1	3		100	3		
		22			100	3					•	-		200			
											-					•	
											1	4		94	2		
	SP		_	_							1	5		100	2	-	SAPE: GREY, SATURATED, MEDIUM TO CO
		20			100	2					-					-	NON-CONESTVE.
											1	4		99	2		
								SAME: GREY, HET, COARSE GRAINED, ORBANIC SHELL-									
																-	
		_					•					.5		98	2		
		23			100	2						17		100	3	-	
		_					-					 17		100	1	-	SAME: GREY, SATURATED, COAPSED GRAIN SMELL, PRAGMENTS.
		22			100											-	SAME: FIME GRAINED SAMO
45.0		रा			100	7	-					24		100	. ;		HONEY COME ANNAUGH SAME.

ALUE ENGINEERING PAYS

r			TH	83~2	<u> 2637</u>
NE	_				£l. 10±
⊢-	A IOIO	; r 			
1	Pl	-4	-200	<u> </u>	DESCRIPTION
•	NP	91	L5 		SILTY GRAVELLY SAND: Brown, MOIST, MON-CONESIVE-
		39	ā	12	SAID: LIGHT BROWN, MOIST, NON-COMESTIVE, MEDIUM GRAINED SAID-
				8	
		ю	7		
 !				•	
•		98	2		
				15	SATE: LIGHT BROWN, MET, MON-COMESTVE, MEDIUM TO COARSE GRAINED SAND-
				15	
		100	:	10	
.		100	2		
		132	4		SATE: GREY, MET, MONTCONESIVE, MEDIUM GRAINED, SHELL ERAGMENTS.
		150	1		
		Эн	:		
		10.	,		SAME. AREY, KATHRATED, METHUM TO CHARSE GRAIMED SAME, MONCONESSIVE-
		×	-		
		·			
		100	3		
		1%			SMT: SREY, SATURATED, COMPSED GRAINED SMID, NOR-CONESTVE, SHELL READMENTS.
		<u> </u>			SAFE: FINE GRAINED SAND-

DEPTH	1.06	MC	u	Pį	-4	-200	Ħ	DESCRIPTION
		3			100	3		SMID: LIGHT BROWN, MOIST, LOOSE, SOME GRAVEL TO 1/2 INCH SHELL FRAGMENTS.
	SP						6	SAME: MEDIUM DENSE-
		11			100	3		SPE: TEMOS BOSES
8.0								SAME: MOIST, GRAVEL TO 2-1/2 INCHES-
								SAMD/SILTY SAMD: LIGHT BROWN, MEDIUM DENSE, WET, SHELL FRAGMENTS-
12-0	SP/SM	22		МP	100	5		
								SAME: GREY-
4.0							24	SAND: GREY, MEDIUM DENSE, MET-
		18			100	4		
	26	16			100	4		

SAME: GRAVEL TO 1/2 INCH-

SAFE: FINE, DENSE, NO GRAVEL.

13 SAMD/SILTY SAMD: GREY, MEDIUM DENSE, WET, GRAVEL TO 1/2 INCH-

TH79-1

61. 10±

EXISTING GROUND

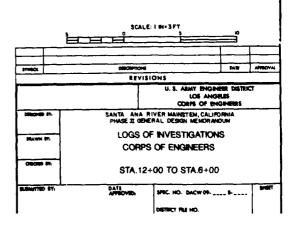
STA 6+00 L

100

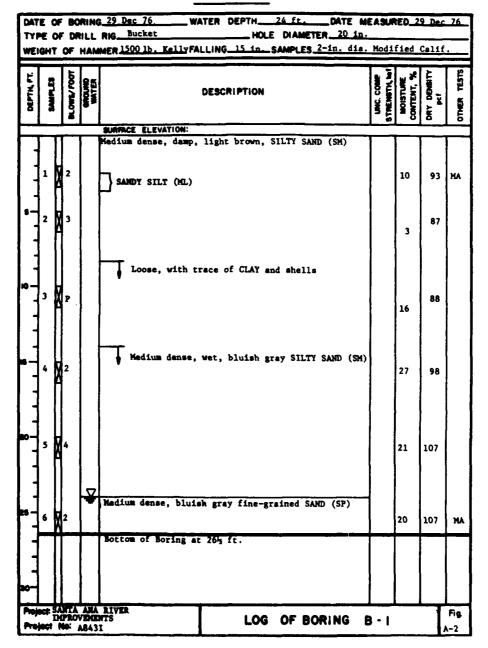
TH79-1

NOTES:

- I. SEE PLATE 28 FOR LOCATION OF TEST HOLES AND TEST TRENCHES.
- 2. SEE PLATE BA FOR LEGEND AND CLASSIFICATION SYSTEM.
- 3 SEE TABLE 6 FOR DATE DRILLED OR EXCAVATED AND TYPE OF EQUIPMENT USED.
- 4. ALL TEST HOLES AND TRENCHES WERE SET UP ON THE LEVEE CREST UNLESS OTHERWISE MOTED AS "INVERT" IN THE CHAMMEL AND "EXISTING GROUND" ON BACK SIDE OF LEVEE.



WC 77-I



NÔTES:

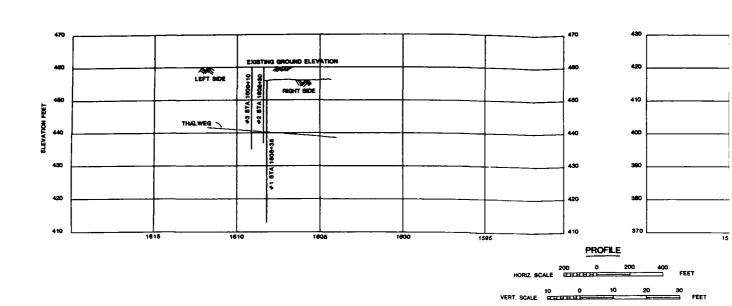
- 1. SEE PLATE 26 FOR TEST SITE LOCATIONS
- 2.SEE TABLES 4 AND 5 FOR LIST OF REPORTS FROM WHICH THESE LOGS WHERE TAKEN. ALL LEGENDS AND EXPLANATIONS AND CONTAINED WITHIN THE REPORTS.
- 3.LOGS BY OTHERS ARE ONLY TO BE USED TO DETERMINE THE GENERAL SOIL PROFILE.

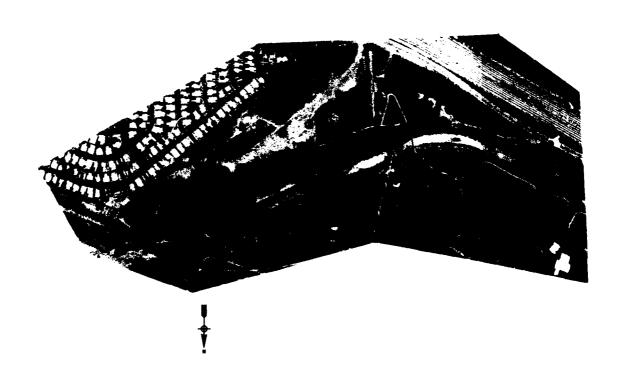
LOWER SANTA ANA RIVER

LOGS OF INVESTIGATION
BY OTHERS
STA. 60+00 TO STA.0+00

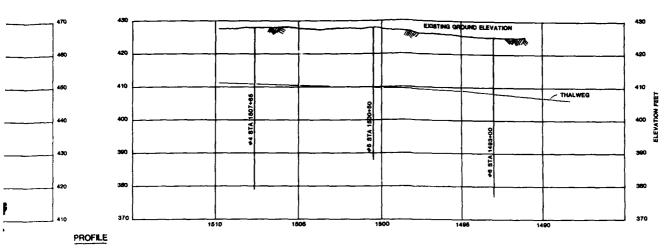
U.S. ARMY CORPS OF ENGINEERS LOS ANGELES DISTRICT

VALUE ENGINEERING PA





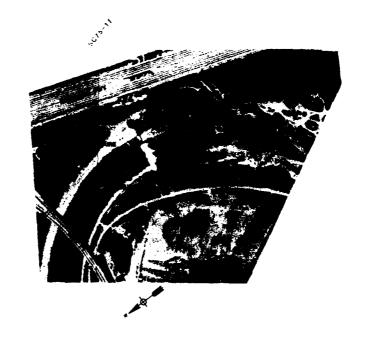
ALUE ENGINEERING PAYS



200 0 200 400

HORIZ SCALE HEHERET TO FEET

10 U 10 20 30





GENERAL NOTES:

- SEE SUBSEQUENT PLATES IN THIS PLATE NUMBER
 SERIES FOR LOGS OF INVESTIGATION.
- 2. THESE REPRESENTATIVE PHOTOGRAPHS WERE TAKEN
- 3. PROPILE ELEVATION WERE DETERMINED IN SEPTEMBER 1987.

			_
9meCL	REVISIONS	MA IN	-
	V. 8	, AMNY BHORNESS DISTRICT LOS ANGELES CORPS OF BHORNESS	_
testa in	SANTA ANA RIVER MAI PHASE IL GENERAL DES	INSTEN, CALIFORNIA DISN MEMORANDUM	
SQLWIN DO.	PLAN AND P	ROFILE	
00000 %	SANTA ANA (CANYON	
NAME OF	ATTECHES SPEC. 16	a. Mcwer b	945
	i construct	RU NO.	

VALUE ENGINEERING PA

TH87-1

THB7-1			_	57A- 1	508+3 5			EL. 4571
DEPTH	L06	MC	ш	PI	-4	-200	N	DESCRIPTION
				160	93	22		SILTY SAND: Brown, MOIST-
	_						3	
	SPI	_12		HP	97	35		SAME: BROWN TO GREY, SLIGHTLY CONESTVE-
9-0		_			97		3	SME: Loose.
11.5	SP/SM			HP	97	6		SAND/SILTY SAND: GREY, MOIST, LOOSE-
11:5		_			100	3	,	SAND: GREY, MOIST, LODSE-
	-	3			94	3		
20.0 21.0	- 1	. 45	.43	9	100	- 78 -		SHOTY SILT: DANK GREY, NET, CORESTYE, PLASTIC-
20.0 1.0	g.	. 16	. 43	1	100	<u></u>		SARDY SILT: DANK GREY, MET, CORESTYE, PLASTIC: SARDY GRAVEL: GREY, CORRSE GRAFRED SAND, COMBLES TO 5 INCHES.
		. 15		1	48	3		SANDY GRAPEL: GREY.COMPSE GRAINED SAND. COMPLES TO 5 INCHES. SANDY GRAPEL/YILLY PAUNEL: "MAN GREY, COMPSE GRAINED.
4.0	SP/GA			- g	48	12	3	SANDY GRAPEL: GREY, COMPSE GRAINED SAND, COMPSES TO 5 THORES. SANDY GRAPEL/SILTY BRANEL: "YARK GREY, COMPSE GRAINED SAND, THICK LAYERS OF COMESTIVE MATERIAL."
4.0	SP/GA	45	57	23	48	12	3	SANDY GRAPEL: GREY.COARSE GRAINED SAND, COMBLES TO 5 THORES. SANDY GRAPE/SILTY BRANKEL: "MARK GREY, COARSE GRAINED SAND, INDICE LAYERS OF COMESIVE MATERIAL." SANDY GLAY: RULE GREY, POIST, A FEW GRAPELS TO 177 THOM. SERY CORESIVE AND PLASTICE.
4.0 6.0 7.0	SP/GA			•	48	12	3	SANDY GRAPEL: GREY, COARSE GRAINED SAND, COMBLES TO 5 INDES. SANDY GRAPEL/SILTY SHAWEL: "MARK GREY, COARSE GRAINED SAND, INDO: LAYERS OF COMESSIVE MATCRIAL." SANDY CLAY: RULE GREY, POIST, A FEM GRAPPLS TO 1/7 INCH.
24.0 26.0 27.0	SP/GA			23	48	12	3 198	SAMOY GRAVEL: GREY.COMESE GRAINED SAMO. COMBLES TO 5 INCHES. SIMOY GRAVELYSILTY BRAINEL: NAME GREY, COMESE GRAINED SAMO, TO CLAYERS OF COMESIVE MATERIAL. SAMOY GLAY: Rule GREY, MOIST, A FEW GRAVELS TO 17? INCH. SERVICE COMESIVE MOIST, CA FEW GRAVEL TO 1 INCH. SILTY SAMO: MULTI COLOR, A FEW GRAVEL TO 1 INCH.
24.0 26.0 27.0	SP/GA			23 NP	48 48 94 97	12 67		SAMOY GRAVEL: GREY.COMESE GRAINED SAND. COMBLES TO 5 INCHES. SIMONY GRAVEL/SILTY BRANKEL: VIANK GREY, COMESE GRAINED SAND. HOLD LAYERS OF COMESIVE MATERIAL. SAMOY GLAY: Rule GREY, MOIST, A FEW GRAVELS TO 17 INCH. SENT COMESIVE MAD PLASTIC. SILTY SAND: MULTI COLOR, A FEW GRAVEL TO 1 INCH.
24.0 26.0 27.0	SP/GA			23 NP	48 94 97 39	12 67 14		SAMEY SHAPEL: GREY, COARSE GRAINED SAND, COMBLES TO 5 INCHES. SAMEY SHAPELYSILTY SHAPEL: "NAME GREY, COARSE GRAINED SAND, INCHES OF COMESSIVE MATERIAL. SAMEY FLAT: RULE GREY, MOIST, A FEM GRAMELS TO 1/7 INCH. SAME COMESSIVE AND PLASTIC. SHILTY SAMD: "MULTI-COLORED, COARSE GRAINED SAND, SOME GRAMEL TO 1 INCH. SAME, GRAMEL TO 5 INCH. COMBLES 10 4 INCH. SAME, GRAMEL TO 5 INCH. COMBLES 10 4 INCH. SAMEY SILTY SHAPEL: BULE GREY, MOON LAWERS OF SAME.
20.0 21.0 24.0 25.0 27.0 29.0	6P/GR 6H 5H 5H 529/5R	u5 -	\$7	23 HP HP	48 94 97 39 53	12 67 14 5		SANDY GRAPEL: GREY, COMPSE GRAINED SAND, COMPSES TO 5 INDESS. SANDY GRAPEL/SILTY SHAPEL: THANK GREY, COMPSE GRAINED SAND, INDO. LAKENS OF COMESSIVE MATERIAL. SANDY GLAY: RULE GREY, MOIST, A FEM GRAPELS TO 1.7? INDM. SERV. COMESSIVE, MOIST, EACH CO., A FEM GRAPEL TO 1. INDM. SAND/SILTY SAND: MULTI-COLORED, COMPSE GRAINED SAND, SOME GRAPELS TO 1. INDM. SAND/SILTY SAND: MULTI-COLORED, COMPSE GRAINED SAND, SOME GRAPELS TO 1. INDM.
224-0 225-0 27-0 29-0 4-0	SP/SM SM SP/SM	28	\$7 37 38	23 MP MP 11	48 94 97 39 53 48	3 12 67 14 5 9		SAMEY SHAPEL: GREY, COMPSE GRAINED SAND, COMPSES TO 5 INCHES TO 5 INCHES. SAMEY SHAPELYSILTY SHAPEL: "MARE GREY, COMPSE GRAINED SAND, INCHES OF COMESSIVE MATERIAL. SAMEY FLAT: RULE GREY, MOIST, A FEM GRAMELS TO 17? INCH. YEAR COMESSIVE AND PLASTIC. SHLTY SAMD: "MULTI-COLONED, COMPSE GRAINED SAND, SOME GRAMEL TO 1 INCH. SAMEL SHAPEL TO 5 INCH, COMBILES 10 4 INCH. SAMEY SILTY SHAPEL: BULE GREY, MOIGH LAWERS OF SAND.
224-0 225-0 27-0 29-0	6P/GR 6H 5H 5H 529/5R	u5 -	\$7	23 NP NP	48 98 94 97 39 53	12 67 14 5 9 24		SANDY GRAPEL: GREY, COMPSE GRAINED SAND, COMPSES TO 5 INCHES TO 5 INCHES TO 5 INCHES TO 5 INCHES TO THE SAND, COMPSES GRAINED SAND, THOSE LANDING OF CONESSIVE MATERIAL. SANDY GLAY: RULE GREY, MOIST, A FEW GRAPELS TO 1.7 INCH. SANDY GLAY: RULE GREY, MOIST, A FEW GRAPELS TO 1.1 INCH. SANDY SILTY SAND: MULTI-COLORED, COMPSES GRAINED SAND, SOME GRAPELS TO 1.1 INCH. SANDY SILTY SAND: MULTI-COLORED, COMPSES GRAINED SAND, SOME GRAPEL TO 5 INCH. SANDY SILTY SANDEL: BUJE GREY, BROWN LAYERS OF SAND, GRAPEL TO 3 INCH.

TH87-2

TH87~2			s	TA- 16	08+30			EL - 450±
DEPTH	L 06	MC	ш	ΡI	4	-200	Я	DESCRIPTION
	SP/SM	9		ΗP	93	6	20	SAMB/STLTY SAMD: LIGHT BROWN, DRY, SL
4-0								
			42	10	98	55		SMIDY SILT: BROWN, DRY, A FBH GRAVELS CHURKS-
		-	32	5	93		29	SAME: PLANK BROWN-
	n.		24	3	99	68	18	SAME: MOIST, SOME WHITE STREAKS, COME
		31	48	15	99	85		SAME: GREY-
				WP	100	84	8	
8-0		v		HР	100	53		SAME: RUBE MITH GREY STREAKS, SOME OR WOOD FIBERS-
			30	1	190	49	11	SILTY SAND: RULE GREY, MOIST, FINE OR FINERS.
	24							
3.0				MP	100	32		

<u>TH87-3</u>

		s	TA. 15	09+10			EL. 45::
L06	ж	LL	Pj	-4	-200	H	DESCRIPTION
59759			WP	100	15		SAMO/STLTY SAMO: RECORD, DRY, LOOSE-
n /N		25	4	100	55	25	SAPPY STUTY CLAY: "TARK BROWN, THEY
		20	4	95	54		SAME: LIGHT BROWN, SLIGHTLY COMENTS
SC/SM		23	4	99	44		SILTY CLAYEY SAND: LIGHT BROWN, DR
4	12	ħ	6	98	55	40	SAMOY SILT: BROWN, MOIST, A FON GRA
a.m.		υ	7	99	69		SAMOY SILT: BROWN, MOIST, A FEW GRA
٩		49	21	99	82		SAMOY SILT: FREY, MOIST-
SC	42	50	8	98	72	11	PLAYEY SAND: BLUE, MOIST, THIN LAVE
5C.75M	n	29	4	99	47	••	STLTY CLAYEY SAND. RLUE GREV WITH B
24			NP	100	29		STETY SAND: "RUIE GREV, MOIST, KINE
20 / ZH			۴	100	12		SAND/SILTY SAND: GREY, WET, FINE YOU LINGE PIECES OF WOOD-
			W	π	- 9-		SAME: GRAVEL TO 1/2 INCH.
	L06 597587 Q./ML 507584 ML Q./ML ML 500 500584	CL/ML SC/SH 12 SC/SH 25 SC/SH	LOS NC LL 99758 CL/ML 25 NL 12 51 CL/ML 27 NL 12 51 CL/ML 27 NL 12 52 SC 42 50 SC/SM 22 24 SM	CL/ML 25 4 SC/SH 25 4 ML 12 31 6 CL/ML 27 7 ML 49 21 SC/SH 22 30 8 SC/SH 22 24 4 SC/SH 22 44	CL/ML 23 A 99 ML 12 31 6 98 CL/ML 27 7 99 ML 49 21 99 SC/SM 22 50 8 98 SC/SM 22 1 99 SC/SM 22 1 99 SC/SM 22 1 99 SC/SM 22 1 99 SM 49 21 99 SM 49 21 99 SM 49 21 99 SM 49 21 99	LOG NC LL P]	106 NC LL P]

LUE ENGINEERING PAYS

TH87-2

2	A. 16	06+30			EL. 450#
ц	PI	4	-200		DESCRIPTION
	r.	93	5	20	SAMD/STLTY SAMD: LIGHT BROWN, DRY, SLIGHTLY CONESTIVE-
10	10	98	 95		SMEDY SILT: BROWN, DRY. A FEW GRAMELS, COMES UP IN ORANGS.
32	5	93	69	29	SAPE: DARK BROWN.
 24	3	99	58	18	SAME: MOIST, SOME WHITE STREAKS, COMESTVE.
46	15	99	55		SAME: GREY.
	*	100	34	8	
	₩	ino	53		SAPE: PLUE WITH GREY STREAKS, SOME ORGANIC MATERIAL, WOOD FIBERS:
*0	:	100	an 	u	SILTY SAND: RESE GREY, MOIST, FINE GRAINED SAND, WOOD FINERS.
	*	1:00	57		

TH87-3

	31	A. 15	09-13			EL: 4512
c	LL	P:	- 14	-210	٠	DESCRIPTION
_		#	100	-2		\$40V\$1(17 \$40) - Now, per, 1005E-
	25	à	199	द्	25	SAMMY SILTY (LAY: "TANK BROWN, DRY-
	2:1	•	15	-i4		SME LIGHT BROWN, SLIGHTLY COMENTED.
	23		39	44		SILTY CLAYEY SAMD: LIGHT BROWN, DRY-
2	<u>n</u>	:	78	35	40	SNEW SILT: BROWN, MOIST, A FEW GRAVEL TO 2 INCHES, CONESIVE.
	ij		7Ģ	59		SHETY SILT: BROWN, MOIST, A FEW GRAVEL TO 2 INCHES, COMESIVE.
_	ga	71	10	82		SAMPLY STLT: FREY, MOEST-
2	· v	3			11	TAYEY SAND: BLUE, MOIST, THIN LAYERS OF SANDY MATERIAL DIGNAL SPELL, PLASTIC-
?	29				••	STETY FLATSY SAME: TILLE GREY WITH BROWN STREAMS, MOIST, FINE GRAINED SAMD-
		•	139	29		STUTY SART: NUR GREY, MOIST, FIRE GRALMED SAND.
			i/10			SMIT/SILTY SAND, FAREY, MET, FIME TO COMPASE GRAINED SAND, LIMITE PIECES OF MODE.
		•	- τ	7		SAFE. FARMEL TO 1/2 INCH-

TH87-4

THB7-4			STA 15					EL . 428±
DEPTH	L06	MC	ш	PI	4	-200	Ħ	DESCRIPTION
	_			NP	96	36	3	SILTY SAMD: LIGHT BROWN, DRY, LOSSE, MEDIUM TO FINE GRAINED SAMD, OCCASIONAL GRAVEL TO 1/2 INCH, SOME GRASS ROUTS.
				₽P	100	 28	12	SME: FINE GRAINED SAND, NO GRAYEL, NO GRASS ROOTS, NEVERT ADDED AT 4 POOT.
	~			JE.	100	21		
	SH			WP	99	23	14	SAME: BROWN WITH STREAKS OF RUST, A FEW GRAVEL-
				NP	100	17		SAME: LIGHT BROWN WITH STREAKS OF RUST-
				жP	99	14		SME: GREY TO BROWN WITH STREAKS OF AUST-
15:0				*	97	19		SME: LIGHT AROSE GRAVEL TO 2.5 INDESS. SMOUSILTY SMO: GREY, FINE TO NETHUM GRAINED SMO. GRAVEL TO 3 THOM, FOR COMBLES NOUNCED TO SURROUNDED.
	5P/5N	_		Мb	91	11		GRAVEL TO 3 INCH, FBM COMMUES ROUNDED TO SUBROUNDED. SME: SOME GRAVEL TO 1/4 INCH.
18-0	SW/SM			NP	83	7		SAND/SILTY SAND: BROWN, FINE TO COARSE GRAINED SAND, GRAVEL TO 3 INCH COBBLES TO 7 INCHES, SUBROMOED.
20.0	GP				48	3		SMIDY GRAVEL: BROWN, COMPSE GRAINED SMID, GRAVEL TO 3 HIGH, COBBLET TO 5 HIGH, ROUNDED MID ANNULIAR, SOME POOCETS SILTY CLUYS:
23.0	 6#	···-	38	8	71	43		SILTY GRAVEL: DANK GREY, SOME CORBULES, COMESIVE, CAVING IN AT 24 PEET.
25.0				ИP	100	43		SILTY SMID: DARK GREY, FINE GRAINED SAID, A FEX GRAVEL, SOME CONESION, SOME ORGANIC MATERIAL.
	24							
<u> 31</u> .0				MP	97	28		SMF: MEDIUM TO CHARSE GRAINED SAND, A FEN GRAVEL TO 1/2 INCH., ROUNDED COBBLES TO 5 INCHES.
	SM/SM			ИÞ	92	9		SMINITH TY SMIN: DANK GREY, REDIUM, TO COARSE GRAINED SMID, SOME GRAVEL TO 1/2 INCH, ROLLIGED CORRLES TO 5 INCHES.
34.0	5 P				83	3		SAMD: GREY, MEDIUM TO COMPSE GRAINED SAMD, GRAVEL TO 1-1/2 INCHES
37.0	SP/SH				65	6		SRAYELLY SAND/SILTY GRAVELLY SAND: GREY, MEDIUM TO COMPS GRAINED SAND, CUBBLES TO 4 INDIES.
40·C				MP	77	5		FRANCLLY SAND/SILLY FRANCLLY SAND: SARY, COMPSE GRAINED SAND, SRANEL TO \$ INDICES CORRECT TO \$ INDICES, POCKETS IF SILLY OR CALL TO
	SW/SM			HP	5 6	5		SWE: NO COMPLES.
46.0					84	2		SMIT: GREY TO HALTI-COLOR, COLORSE GRAINED SAND, GRAVEL TO 1/2 INCH, SMALL POCKETS OF BROWN CLAY OR STLET-
49-0								

NOTES

- 1. SEE PLATE 27 FOR LOCATION OF TEST HOLES.
- 2 SEE PLATE BA FOR LEGENO AND CLASSIFICATION SYSTEM

SCALE:1 N.* 3 FT.

STINEOU DECEMBERS

STINEOU DECEMBERS

REVISIONS

U.S. ARRIVE PROBRESS DISTRICT

LOG ANOBLES

DISTRICT

LOG ANOBLES

SOUTH OF PROBRESS

PHASE E GENERAL DESIGN MEMORANDUM

LOGS OF INVESTIGATIONS

CORPS OF ENGINEERS

STALEOUS PA

STALEOUS PA

STALEOUS PA

STALEOUS PA

DESTRICT FILE NO.

SHEET

APPROVED.

VALUE ENGINEERING PA

THB7-5	5			STA 15	00+50			EL - 428t
DEPTH	L06	MC	LL	PI	-4	-200	N	DESCRIPTION
•	SN/SN			ИP	99	11	11	SAMD/SILTY SAMD: LIGHT BROWN, DRY, FINE GRAINED SAMD, SOME GRAMEL, GRASS ROOTS, SOME COMMLES TO 5 INCHES-
3.0	SM			₩P	99	34	4	SILTY SMID: LIGHT BROWN, MOIST, LOUSE, FINE GRAINED SAND SMALL PIECES OF CEMENTED SAND, REVERT ADDED-
6.0			30	1	100	70		SANDY SILT: LIGHT BROWN WITH STREAK OF RUST, FINE GRAINES SAND-
	•		49		100	90		
12.0	SM			۴	100	18		SILTY SAND: LIGHT BROWN, FINE TO MEDIUM GRAINED SAND-
5.0_				10	99	3	26	SMD/SILTY SMD: LIGHT BROWN, FIRE TO MED-, GRAINED SAND, SORE GRAVEL TO 3 INDIES, SUBPOUNDED.
	SN/SH			MP	82	6		
3.0	φ				50	2		SANDY GRAVEL: LIGHT BROWN AND GREY, CDANSE GRAINED SAND, CORRLES TO 4 INCHES.
6.0	SW/SM		_	¥	81	6		SAMIL/SILTY SAMID: GREY, COARSE GRAINED SAMID, GRAVEL TO 1 MICH, SOME SHALL POCKETS OF SILTS:
1.0								
			38	3	74	26		SILTY SRAVELLY SMID: GREENISH GREY, MOIST, FINE SAND, GRAPEL TO \$ INCHES, SOME COMBLES TO \$ INCHES, CONESIVE-
	SM _		31	3	75	19		SME: Streaks of rust colored material.
.0	-	-	1	3	72	44		SAME: VEINS OF COARSE GRAINED SAME
	\$P/\$#			w	53	5		PRAFELLY SAND/FRAMELLY SILTY SAMP: GREYISH GREEN, LOOSE, FINE TO COARSE GRAINED SAND, SOME CORNLES TO 10 IMONES, SOME OFFICIAL PRAFERIA.

THB7-6				STA 14	93+00		EL. 427t
DEPTH 	L06	нс	u	Pj	-4	-200	N DESCRIPTION
		4	37	6	95	56	SAMOY SILT: LIGHT BROWN, DRY, FINE GRAINED S. GRAVEL, LOOSE.
	n.	6	33	5	100	73	SAME: MOIST-
8-0			41	13	99	71	SAME: Some organics-
11.0	SM	-	24	4	100	31	SILTY SMID: LIGHT BROWN-GREY, FINE TO MEDIUM SMID.
· · · · · · · · · · · · · · · · · · ·				MP.	58	7	GRAVELLY SAMD/SILTY GRAVELLY SAMD: BROWN, FINGRAINED SAMD, SOME GRAVEL
	SP/SH			*	57	7	SAME: BROWN-GREY, MEDIUM TO COARSE GRAINED SA TO 3 INCHES, SUBANGULAR TO SUBROLADED.
	or≀on	_		4P	57	7	SAME: DANK BROWN, COMPSE GRAIND SAND, GRAVEL COBBLES TO 6 INCHES, DRILLING VERY DENSE-
1.5			?5	1	56	16	SILTY GRAVELLY SAND: TARK GREY, COARSE GRAINET GRAVEL TO 3 INCHES, SOME COBBLES.
	S M		31	,	75	21	SAME: GRAVEL TO 1.5 INCHES-
1.0				ИC	54	8	GRAVELY SAMM/SILTY GRAVELLY SAMD: DARW GREY COMESE GRAVED SAMD, GRAVEL TO 3 MODES, SOME COMESIVE MATERIAL.
2	H/SM .			we.	58	10	
.0	æ				58	3	SRAVELLY SMID: DARK GREY, MEDIUM TO COARSE GRAINER TO 3 INCHES, CORRUES TO 10 INCHES, ROYNCE
				40	66	9	GRAVELLY SAMD/SILTY GRAVELLY SAMD: "ARY GREY." CDARSE GRAINED SAMD, GRAVEL TO 3 INDES: CLUMPS MITTISH BUIE WATERIAL WHICH HAD A STROMG PROADLE AT QU'ERET.
SI	n/sm -			ήc	71	8	
				ψp			

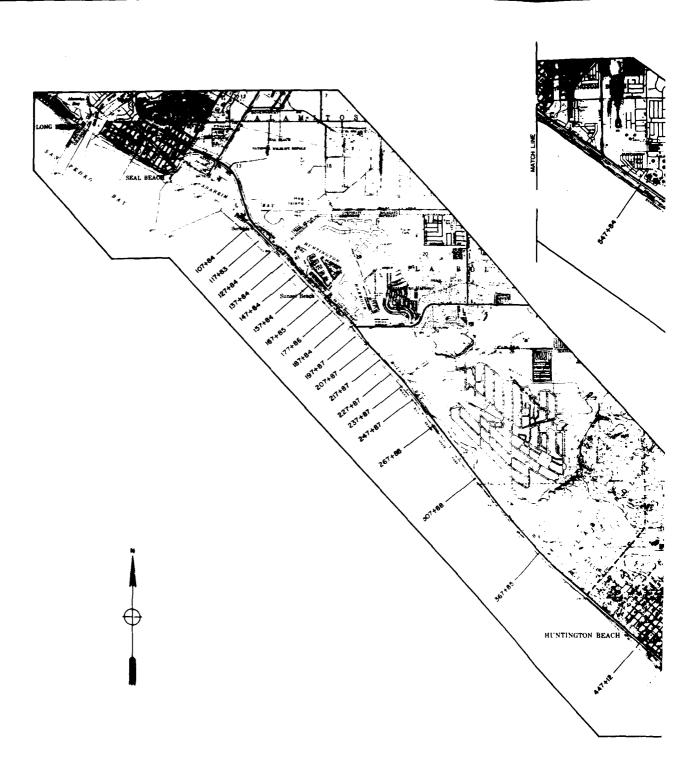
LUE ENGINEERING PAYS

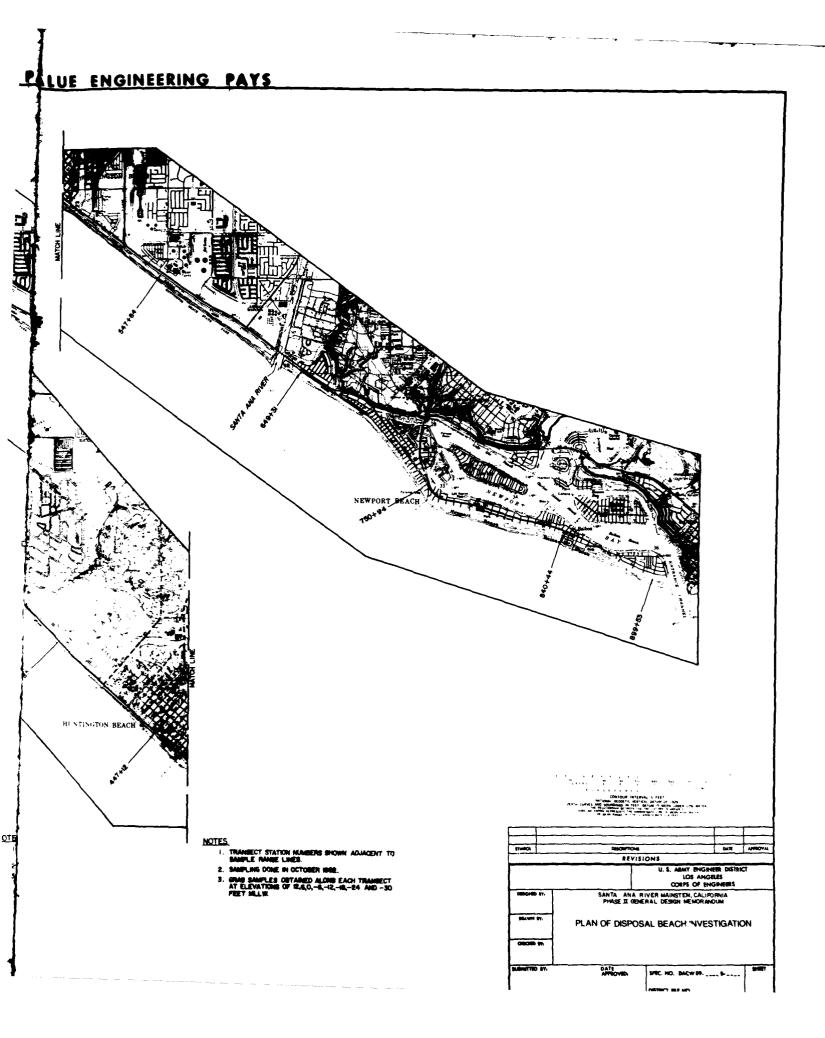
5+00			EL · 427±
-4	-200	N	DESCRIPTION
95	56		SAMDY SILT: LIGHT BROWN, DRY, FINE GRAINED SAMD, FEN
130	73		SAME. MOEST-
96	יו	!	SAME: SOME ORGANICS-
100	11		SILTY SWID: LIGHT BROWN-GREY, FINE TO MEDIUM GRAIMED
58			RAYELLY SAND/SILTY GRAVELLY SAND: BROWN, FINE TO COARSE FRAINED SAND, SOME GRAVEL.
57	,	,	SAPE: ROMM-GREY, MEDIUM TO CDARSE GRAINED SAMD, GRAMEL TO 3 (MONES, SUBMIGULAR TO SUBROUNDED)
57	,	5	CAPE "AMR BROWN, COMPSE GRAIND SAND, GRAVEL TO 2 INCHES, TO 5 INCHES, DRILLING VERY ODNSE-
		į	OF TO SPANFLLY SAME. PARK GREY, COARSE GRAINED SIND, PARK OF CORBLET.
75	.;	5	YMF - RRAYEL TO 1.5 INDHES∙
<u>"</u>	;	j	RAYS : AMPLYSILTY SHAPELY SAND: DANG GREY, LOOSE, WARS GRAINED SAND, GRAMEL TO 3 THORES, SOME OTRALES, BAPTAMOED, POOCEYS OF CONESIVE MATERIAL.
68			
59		ā	PANELY SAMD. DAMK GREY, MEDIUM TO COARSE GRAIMED SAMD, PAREL TO 3 INCHES, COMBLES TO 10 INCHES, ROUNDED.
br	1		PART ." CAMPISTUTE OF RELLET SAME). PARE GREY, MEDIUM TO THESE OF ALMED SAME, ORANGE TO 3 INCHES, CLUPPS OF A THE STATE OF ALMERICA, WHICH HAD A STROME SAGANIC GOOD THE FEET.
•;	2		
*			

NOTES

1 SEE PLATE 27 FOR LOCATION OF TEST HOLES
2 SEE PLATE BA FOR LEGEND AND CLASSIFICATION
3YSTEM

SCALE IN 1 3 FT





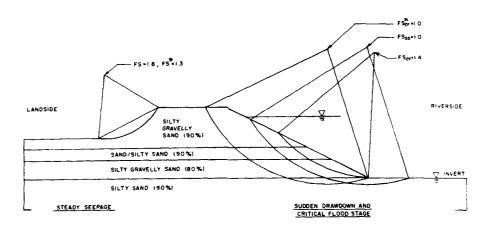
VALUE ENGINEERING

REACH CROSS

Left Ty Right Ty Left Co Right Co

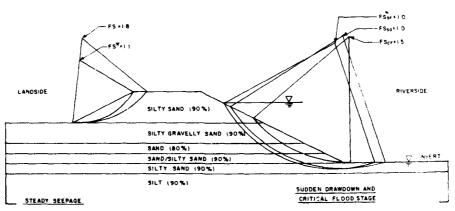
LEVEE	DESIGN	PARAMETERS
LEVEE	DESIGN	LWUMME' I FILE

DESIGN	MAJGMUM	OPTIMUM MOISTURE		R STR	ENGTHS			S STRE			UI	LOOSE 80%	T	UA	DENSE	iΤ
PARA-	WEIGHT	CONTENT W.C.	/ 80	OSE ON ACTION)	DEN 90 COMPA	o% \	COMP	۱ %	/ 90	NSE 0% ACTION)	AVERAGE	MPACTION MOIST WEIGHT	SATURATED	AVERAGE I	90% DMPACTIO MOIST UNIT WEIGHT	N) SATURATED WEIGHT
SOIL	(PCF)	(%)		CONESION			FRICTION ANGLE (DEGREES)	COHESION (PSF)		COHESION (PSF)	UNIT WEIGHT PGF)	WEIGHT (PCF)	WEIGHT (PCF)	DRY UNIT WEIGHT (PCF)	WEIGHT	WEIGHT
CLAY	121	11	15	600	23	600	24	200	30	200	99	109	124	11.)	123	132
SILT	117	12	20	200	25	400	26	80	32	100	94	104	122	105	117	129
SILTY GRAVELLY SAND	130	8	28	0	35	0	32	0	37	0	104	115	128	117	127	136
SAND	118	13	27	0	33	0	31	0	36	٥	94	106	122	106	120	129
SILTY	119	12	24	200	30	300	28	0	34	0	95	107	123	107	121	130
SAND/ SILTY SAND	123	11	26	0	32	0	30	0	35	0	98	109	124	111	122	131
CLAYEY SANC		8	22	400	27	400	2 6	100	32	100	104	113	128	117	127	136



LEFT LEVEE

TYPICAL TCROSS SECTION SCALE IN . IOFT



LEFT LEVEE

LEGEND

FS - FACTOR OF SAFETY.

FS - FACTOR OF SAFETY WITH SEISMIC COEFFICIENT OF 0.15G.

FS₃₀ - FACTOR OF SAFETY FOR SUDDEN DRAWDOWN.

FS_{CF} FACTOR OF SAFETY FOR CRITICAL FLOOL STAGE (MAXIMUM DESIGN FLOOD CONDITION) TYPICAL CROSS-SECTION GENERALLY REPRESENTS THE MOST COMMON SOLIC COMDITIONS:
COMPOSITE CROSS-SECTION GENERALLY REPRESENTS WEAKER MATERIALS AND LOCALLY

HIGHER LEVEES.

NOTES:

- 1.END OF CONSTRUCTION ANALYSIS WAS NOT PERFORMED ON EXISTING LEVEES SINCE IT IS NOT APPLICABLE.
- 2. PERCENTS190 %, 80%) REPRESENT PERCENT RELATIVE COMPACTIONS USED IN ANALYSES; SEE LEVEE DESIGN PARAMETERS TABLE.
- 3. STABILITY CROSS SECTIONS ANALYZED WITH IV ON 2H SIDE SLOPES

COMPOSITE T CROSS SECT

RALUE ENGINEERING PAYS

PCF

123

117

120

: 22

: 27

PCF

132

129

130

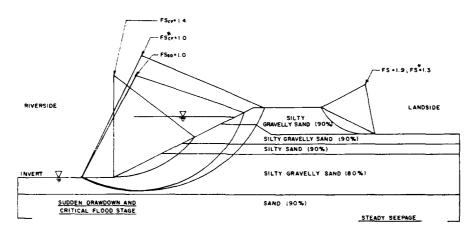
31

36

FACTOR OF SAFETY FOR SLOPE STABLITY ANALYSIS (EM 1110 - 2-1913 DATED 31 MARCH 1978)

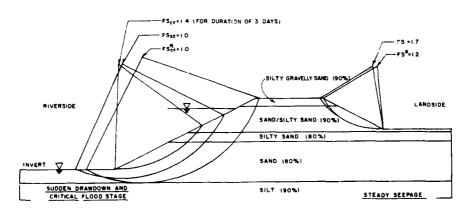
			R	VERSIDE				LAND	SIDE	
REACH	CROSS SECTION	EOC	W/EQ	SD	CR/FL	-Stage W/EQ	EOC	EOC W/EQ	\$\$	SS W/EQ
	(Req min FS)	1.3	1.0	1.0	1.4	1.0	1.3	1.0	1,4	1.0
i.	Left Typical - Existing	NA	NA	1.0	1.4	1.0	NA	NA	1.8	13
	Right Typical - Existing	NA	NA	1.0	1.4	1.0	NA	NA	1.9	13
	Left Composite - Existing	NA	NA	1.0	1.5	1.0	NA	NA	1.8	1.1
	Right Composite - Existing	NA	NA	1.0	14	1.0	NA	NA	1.7	1.2

FACTOR OF	SAFETY TABLE NOTES:
£00	. End of Construction
SD	. Sudden Drawdown
Cr. / F1	- Critical Flood
SS	Steady Seepage
W/EQ	. Applied Earthquake Seismic COEF =0.15 (
	Not Applicable



RIGHT LEVEE

TYPICAL TOSS SECTION



RIGHT LEVEE

COMPOSITE CROSS SECTION

SCALE IIN - IOFT
10 0 10 20 30

STREECK.	MICHITICHS	DATE	MPROVA				
	REVIS	IONS					
		U. S. ARMY ENGIN LOS ANGI CORPS OF EN	1.05	cī			
Magrato er.		RIVER MAINSTEM, CALIFO ERAL DESIGN MEMORAN					
SEATON SIL	SLOPE STABILITY CONDITIONS						
ŀ		REACH 1					
00000	EXISTING SOIL CONDITIONS						
	RIGHT AND LEFT LEVEES						
	DATE	SPEC. HO, BACWOF.		1 2000			

VALUE ENGINEERING

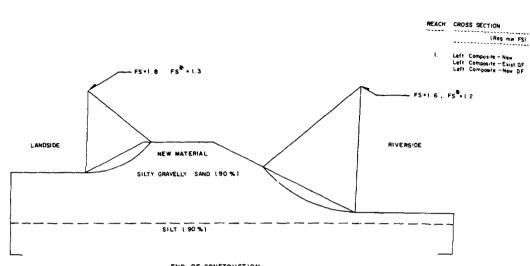
FACTOR OF SAFETY FOR SLOPE STABILITY ANA

1.0

RIVERSIDE EOC EOC SD Cr./FI.-Stage W/EQ. W/EQ.

1.0 1.4

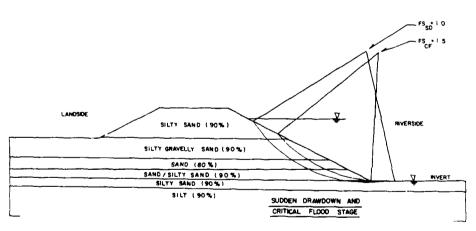
1.0



END OF CONSTRUCTION

NEW CONDITION (See notes I and 2)

COMPOSITETCROSS SECTION



EXISTING DRAINED FACE CONDITION

LEGEND

COMPOSITETCROSS SECTIO

FS — FACTOR OF SAFETY
FS — FACTOR OF SAFETY WITH SEISMIC COEFFICIENT OF 0 15G.
FS SD — FACTOR OF SAFETY FOR SUDDEN DRAWDOWN
FS CF — FACTOR OF SAFETY FOR CRITICAL FLOOD STAGE (MAXIMUM DESIGN FLOOD CONDITION).

TYPICAL CROSS SECTION GENERALLY REPRESENTS. THE MOST COMMON SOIL COMOVITIONS: COMPOSITE CROSS SECTION GENERALLY REPRESENTS WEAKER MATERIALS AND LOCALLY HIGHER LEVEES.

✓ — WATER SURFACE

NOTES:

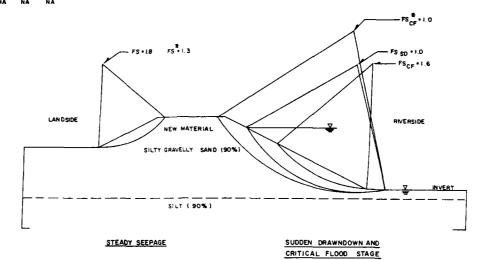
- I NEW LEVEES WERE ANALYZED FOR END OF CONSTRUCTION 2 NEW REFERS TO THE SOIL CONDITION AFTER RECONSTRUCTION.
- 3. SEE PLATE A-29 FOR LEVEE DESIGN PARAMETERS.
- 4. PERCENTS (90%,80%) REPRESENT PERCENT RELATIVE COMPACTIONS USED IN ANALYSES. SEE LEVEE DESIGN PARAMETERS TABLE. 5 STABILITY CROSS-SECTIONS ANALYZED WITH IV ON 2H SIDE SLOPES.

ALUE ENGINEERING PAYS

PR OF SAFETY FOR SLOPE STABILITY ANALYSIS

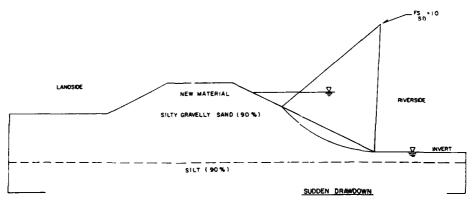
min FS)

	RIVERSIDE					LAND	SIDE		FACTOR OF SAFETY TABLE NOTES
€oc	EOC W/EQ	SD	Cr. /Fi	-Stoge W/EQ	EOC	EOC W/EQ	ŠŠ	SS W/EO	EOC End of Construction SD Sudden Drawdown
1 3	1 0	1.0	1.4	1.0	1.3	1.0	1.4	1.0	Cr./Fl Critical Flood SS Steady Seepage
16	1.2	10	1.6	1.0	J.8	1.3	1.8	1.3	W/EQ Applied Earthquake Seismic COEF. = 0.15 G NA Not Applicable
N A	NA	1.0	1.5	NA	NA	NA	NA	NA	



NEW CONDITION (See notes 1 and 2)

COMPOSITE CROSS SECTION SCALE I IN -10 FT



NEW DRAINED FACE CONDITION (SEE NOTES | AND 2)



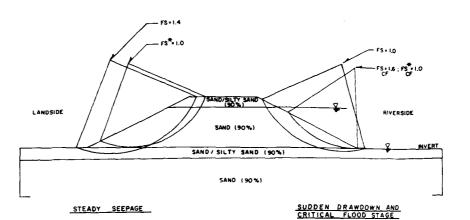
\$CALE IIN * 10 FT

			T						
ETMBCL	DESCRIPTIONS	DATE	MECH						
	REVISION	IS .							
		U. S. ARMY ENGINEER DIST LOS ANGELES CORPS OF ENGINEERS	HCT						
DELIGN GO SY.	PHASE II GENERAL	SANTA ANA RIVER MAINSTEIL, CALIFORNIA PHASE ZI GENERAL DESIGN MEMORANDUM SLOPE STABILITY CONDITIONS							
SEAWN SV.	EXISTING SO	REACH 1 EXISTING SOL CONDITIONS LEFT LEVEE							
GROSS IV	REACH 1	REACH 1 AND REACH 2 NEW SOIL CONDITIONS							
REMITTED BY.	DATE ATTROVER	W. HO. BACW 81 B	- 946						
		FRICT FLE NO.							

TA**R**I E

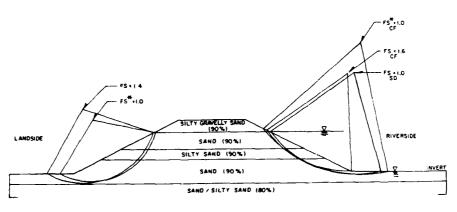
VALUE ENGINEERING I

	FACTOR OF	SAFETY	FOR	SLOPE	STA	<u>BILIT'</u>
	FACTOR S.			VERSIDE		
REACH	CROSS SECTION	ÉÓC	EOC W/EQ	SD	0.7FI	Stege W/EQ
	(Reg. min FS)	1.3	1.0	1.0	1.4	1.0
2	Left Typical — Existing Right Typical — Existing Left Composite — # 1 Left Composite — # 2	NA NA NA	NA NA NA	1.0 1.0 1.0	1.6 1.5 1.6 1.5	1.0 1.0 1.0



LEFT LEVEE

TYPICAL CROSS



STEADY SEEPAGE

SUDDEN DRAWDOWN AND CRITICAL FLOOD STAGE

LEFT LEVEE NO.1

COMPOSITE CROS

- FS FACTOR OF SAFETY
- ${\sf FS}^{\mbox{\scriptsize M}}-$ factor of safety with seismic coefficient of 0.15 g.
- $\mathsf{FS}_{\overline{\mathsf{SD}}}$ FACTOR OF SAFETY FOR FOR SUDDEN DRAWDOWN
- FS CF FACTOR OF SAFETY FOR CRITICAL FLOOD STAGE (MAXIMUM DESIGN FLOOD CONDITION).
- † GENERAL CROSS-SECTION GENERALLY REPRESENTS THE MOST COMMON SOIL CONDITIONS: COMPOSITE CROSS-SECTION GENERALLY REPRESENTS WEAKER MATERIALS AND LOCALLY HIGHER LEVEES.
- ▼ WATER SURFACE

NOTE:

- 1 END OF CONSTRUCTION ANALYSIS WAS NOT PE FORMED ON EXISTING LEVEES SINCE IT IS NOT APPLICABLE.
- 2. SEE PLATE ARD FOR LEVEE DESIGN PARAMETERS.
- 3. PERCENTS (90%, 80%) REPRESENT PERCENT RELATIVE COMPACTIONS USED IN AMALYSES; SEE LEVEE DESIGN PARAMETERS TABLE
- 4. STABILITY CROSS-SECTIONS ANALYZED WITH IV ON PH SIDE SLOPES.

ALUE ENGINEERING PAYS

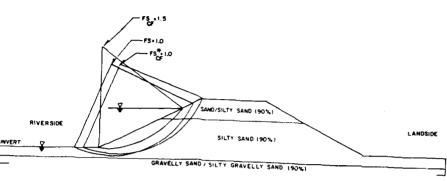
FACTOR OF	SAFETY	FOR	SLOPE	STA	BILITY	ANALY	<u> (SIS</u>		
			VERSIDE					SIDE	
ROSS SECTION	EOC	EOC W/EQ	SO	G. /F1.	- Slege W/EQ.	ĒŎĊ	EOC W/EQ.	33	SS W/EQ.
(Reg. min FS)	1.3	1.0	1.0	1.4	1.0	1.3	1.0	1,4	1.0
iical - Existing	NA NA	NA NA	1.0	1.6	1.0	NA NA	NA NA	I 4 NA	I O
vocaite - # 1	NA	N/A	1.0	1.6	1.0	NA	NA	1.4	10
reposite - ex 2	NA	NA	1.0	1.5	1.0	NA	NA	NA	NA

FACTOR OF SAFETY TABLE NOTES: EOC. SD Cr./FI SS

End of Construction Sudden Drowdown Critical Flood Steady Seepage Applied Earthquake Seistric COEF + 0.15 G Nor Application W/EO NA....

FS: 1.6 .FS 1.0 RIVERSIDE

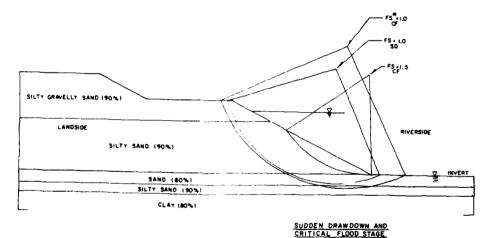
NVERT



SUDDEN DRAWDOWN AND CRITICAL FLOOD STAGE

RIGHT LEVEE

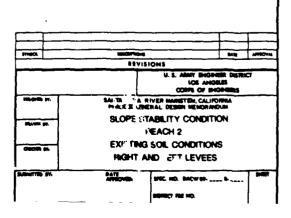
TYPICAL TOROSS SECTION

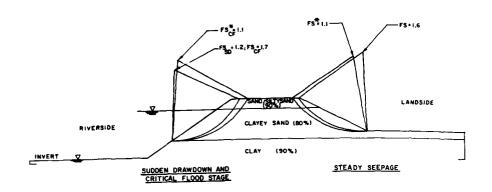


LEFT LEVEE NO.2

COMPOSITE CROSS SECTION

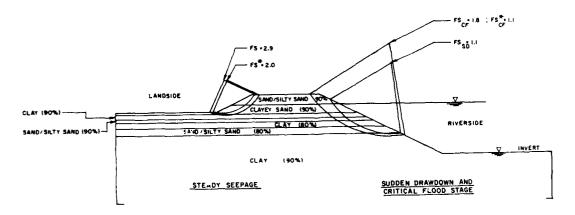






RIGHT LEVEE

TYPICAL TOROS SECTION



LEFT LEVEE

COMPOSITE CROSS SECTI

LEGEND

FS - FACTOR OF SAFETY

FS#- FACTOR OF SAFETY WITH SEIMIC COEFFICIENT OF 0.15G.

FS SO FACTOR OF SAFETY FOR SUDDEN DRAWDOWN.

FSCF FACTOR OF SAFETY FOR CRITICAL FLOOD STAGE (MAXIMUM DESIGN FLOOD CONDITION).

TYPICAL CROSS-SECTION GENERALLY REPRESENTS THE MOST COMMON SOIL CONDITIONS: COMPOSITE CROSS-SECTION GENERALLY REPRESENTS WEAKER MATERIALS AND LOCALLY HIGHER LEVEES.

T -- WATER SURFACE

NOTE

- I. END OF CONSTRUCTION ANALYSIS WAS NOT PERFORMED ON EXISTING LEVEES SINCE IT IS NOT APPLICABLE.
- 2. SEE PLATE A-29 FOR LEVEE DESIGN PARAMETERS.
- 3. PERCENTS 190%, 80%) REPRESENT PERCENT RELATIVE COMPACTIONS USED IN ANALYSES; SEE LEVEE DESIGN PARAMETERS TABLE.
- 4. STABILITY CROSS-SECTIONS ANALYZED WITH IV ON 2H SIDE SLOPES.

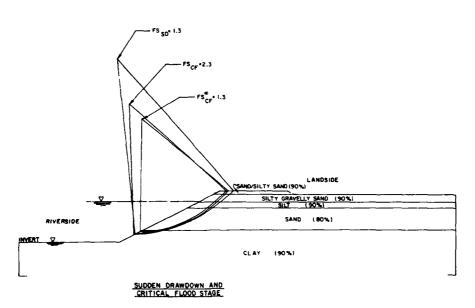
ALUE ENGINEERING PAYS

FACTOR OF SAFETY FOR SLOPE STABILITY ANALYSIS

			1	RIVERSIDE	E	LANOSIDE				
REACH	CROSS SECTION	EOC	EOC W/EO.	\$D	Cr/FI.	STAGE W/EQ.	EOC	EOC W/EQ.	ss	SS W/EQ.
	Reg. min. FS	1.3	1.0	1.0	1.4	1.0	1.3	1.0	1.4	1.0
3	Right Typical - Existing	NA	NA	1.2	1.7	1.1	NA	NA	1.6	1.1
	Left Composite - Existing	NA	NA	1.1	1.8	1.1	NA	NA	2.9	2.0
	Right Composite - Existing	NA	NA	1,3	2.3	1.3	NA	NA	NA	NA

FACTOR OF SAFETY TABLE NOTES:

EOC . End of Construction
SD . Sudden Drawdown
Cr /FL . Crincol Flood
SS . Steady Seepage
W/EQ . Applied Earthquake Sers mic COEF = 0.15G
NA . Not Applicable



RIGHT LEVEE

COMPOSITE CROSS SECTION
SCALE: IN. - IOFT.

VERT

SCALETHN. IOFT.

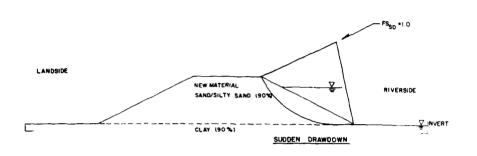
SYMBOL .	98GH71046	DATE	APPROV								
	REVISIONS	REVISIONS									
		ARMY ENGINEER DISTR LOS ANGELES ORPS OF ENGINEERS	OCT .								
	SANTA ANA RIVER MANS PHASE II GENERAL DESK										
BRAWN DY,	SLOPE STABILITY	SLOPE STABILITY CONDITION									
1	REACH 3										
0808 W.	EXISTING SOIL C	EXISTING SOIL CONDITIONS									
	RIGHT AND LEFT LEVEES										
ALBERTAN BY.	DATE SPEC. NO.	SPEC. NO. SACWOR									

VALUE ENGINEERING PA

FACTOR OF SAFETY FOR SLOPE STABILITY ANALYSIS

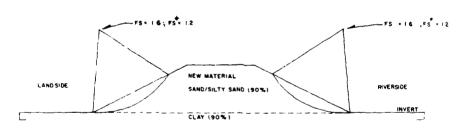
LANDSIDE

				LAN				
REACH	CROSS SECTION	EOC EOC SD Cr /F1 -Stoge W/EQ STAGE W/EQ		ÉOC	EOC W/EQ			
	(Reg min FS)	13	1.0	1.0	1.4	10	1 3	1.0
3,	Left Typical - New, wi D.F. Left Typical - New, *2 D.F. Left Typical - New	NA NA 1 S	AA AA 2 i	1.0 1.1 1.0	N A N A L-7	NA NA I.O	N A N A I .6	NA NA 1-2



LEFT LEVEE #1 DRAINED FACE

TYPICAL+ CROSS SECTION



END OF CONSTRUCTION

LEFT LEVEE

TYPICAL TOROS SECTION

LEGEND

F3 — FACTOR OF SAFETY
F3A — FACTOR OF SAFETY WITH SEISMIC COEFFICIENT OF 0.15G
F5 — FACTOR OF SAFETY FOR SUDDEN DRAWDOWN.
F3 — FACTOR OF SAFETY FOR CRITICAL FLOOD STAGE (MAXIMUM DESIGN FLOOD CONDITION).

TYPICAL CROSS SECTION GENERALLY REPRESENTS THE MOST COMMON SOIL CONDITIONS COMMONSTE CROSS SECTION GENERALLY REPRESENTS WEAKER MATERIALS AND LOCALLY HIGHER LEVERS
WATER SUPPRACE

NOTES

NEW LEVERS WERE ANALYZED FOR END OF CONSTRUCTION.

NOTES

I. NEW LEVEES WERE ANALYZED FOR END OF CONSTRUCTION.
2" NEW" REFEERS TO THE SOIL CONDITION AFTER RECONSTRUCTION.
3. SEE PLATE A29 FOR LEVEE DESIGN PARAMETERS.
4PERCENTS 190%, 80%) REPRESENT PERCENT RELATIVE COMPACTIONS
USED IN AMALYSES; SEE LEVEE DESIGN PARAMETERS TABLE.

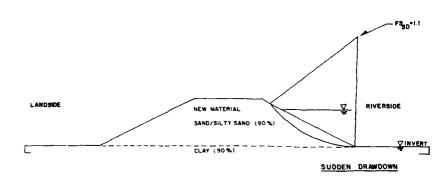
ALUE ENGINEERING PAYS

OR OF SAFETY FOR SLOPE STABILITY ANALYSIS

		R	VERSIC	Æ	LANOSIDE					
	EOC	EOC W/EQ	SD	Cr /FI.	-Stage W/EQ	EOC	EOC.	SS	SS WED	
n FS)	1.3	10	10	1.4	10	1.3	1.0	1.4	1.0	
. =1 DF	NA NA	NA NA	10	NA NA	NA NA I.O	N A N A	NA NA L.2	NA NA	NA NA	

FACTOR OF SAFETY TABLE NOTES:

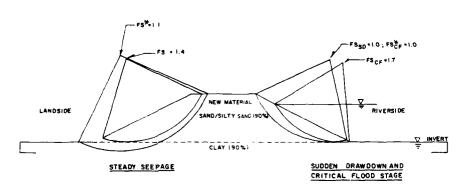
EOC. End of Construction
SD. Sudden Drawdown
Cr./Fl. Critical Flood
SS. Sieady Seepage
W/EQ. Applied Earthquake Seismic CQEF=0,15G
NA. Not Applicable



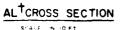
LEFT LEVEE #2 DRAINED FACE

AL TOSS SECTION SCALE LIN . 10 FT

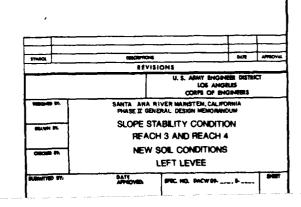
INVERT



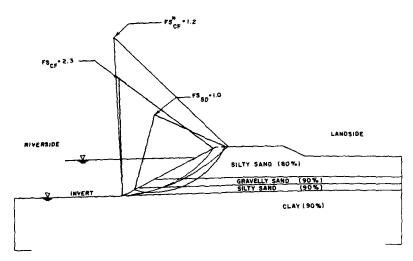
LEFT LEVEE







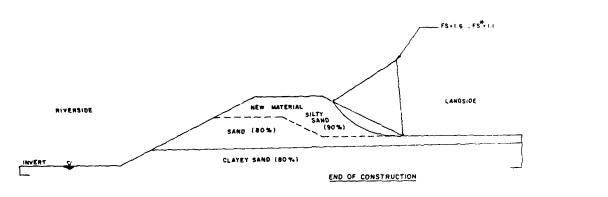
VALUE ENGINEERING PAT



SUDDEN DRAWDOWN AND CRITICAL FLOOD STAGE

EXISTING CONDITION

TYPICAL+ CROSS SECTION



NEW CONDITION (SEE NOTES | AND 2)

COMPOSITE CROSS SECTION

RIVERSIDE

INVERT V

LEGEND

- FS FACTOR OF SAFETY
- FS* FACTOR OF SAFETY
- FS FACTOR OF SAFETY FOR SUDDEN DRAWDOWN.
- FSCF FACTOR OF SAFETY FOR CRITICAL FLOOD STAGE (MAXIMUM DESIGN FLOOD CONDITION).
 - TYPICAL CROSS-SECTION GENERALLY REPRESENTS THE MOST COMMON SOIL CONDITIONS:
 COMPOSITE CROSS-SECTION GENERALLY REPRESENTS WEAKER MATERIALS AND LOCALLY HIGHER LEVERS.

WATER SURFACE

NOTES.

- I. END OF CONSTRUCTION ANALYSIS WAS NOT PERFORMED ON EXISTING LEVEES SINCE IT IS NOT APPLICABLE.
- 2."NEW" REFERS TO THE SOIL CONDITION AFTER RECONSTRUCTION.
- 3. SEE PLATE A-29 FOR LEVEE DESIGN PARAMETERS.
- 4 PERCENTS 90%, 80% REPRESENT PERCENT RELATIVE COMPACTIONS. USED IN ANALYSES; SEE LEVEE DESIGN PARAMETERS TABLE.

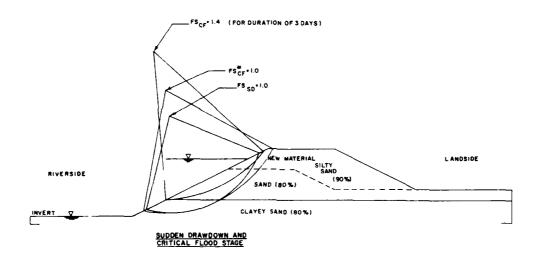
FACTOR OF SAFETY FOR SLOPE STABILITY ANALYSIS

			LANOSIDE							
REACH	CROSS SECTION	EOC	EOC W/EQ.	\$D	Cr./ F1.	STAGE W/EQ.	EOC	EOC W/EQ.	ss	SS W/EQ.
4	(Req min FS) Right Typical-Existing	_1.3	- I.O	1.0	-1.4 -2.3	1.0	-1.3 -NA		- I.A - NA	1.0 NA
	Right Composite - Exist / New	NA	NA	1.0	1.4	1.0	1.6	1.1	NA.	NA.

FACTORY OF SAFETY TABLE NOTES:

EOC. ... End of Construction
SD Sudden Drd wdown
Cc./FI. Critical Flood
SS Steady Seepage
W/EQ. Applied Earthquake Seit
NA. Not Applicable

Seismic COEF, ±0.15G



EXISTING / NEW CONDITION (SEE NOTES | AND 2)

COMPOSITE TCROSS SECTION

TERS TABLE.

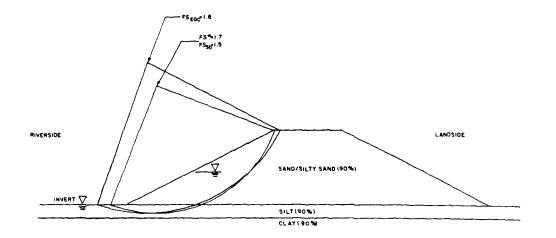
9CALE:11N.+10FT. 10 0 10 20

SYMBOL	DECEPTIONS		DATE	APPROVA							
	REVIS	IONS									
		U. S. ARMY ENGINE LOS ANGE CORPS OF ENG	LES	a							
DESCRIPTO PY.		A ANA RIVER MAINSTEM, CALIFORNIA SE II GENERAL DESIGN MEMORANDUM									
SEAWN ST.		SLOPE STABILITY CONDITION REACH 4 NEW AND EXISTING SOIL CONDITIONS									
deciso en	NEW AND EX										
	RK	GHT LEVEE									
LEWITTED BY:	DATE	SPEC NO. DACWOP-	1 2000								

VALUE ENGINEERING PA

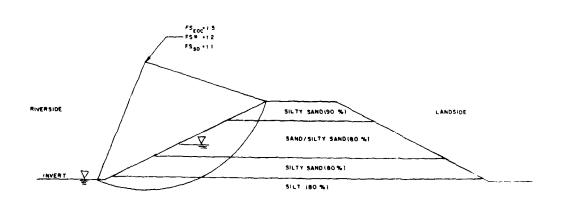
BEACH

5



RIVERSIDE INVERT V

TYPICALT CROSS-SECTION



WEAK EMBANKMENT

LEGEND

FS FACTOR OF SAFE FSEC - FACTOR OF S FS SO - FACTOR OF SE T -TYPICAL CRC

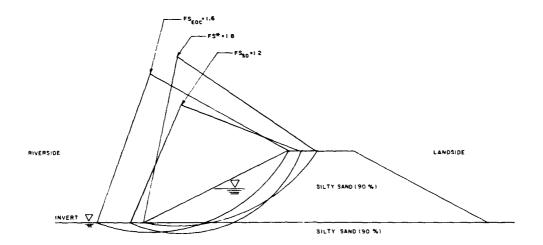
NOTES

- I SIDE SLOPES INREA
 2 SEE PLATE 29 FI
 3 PERCENTS 190 %, 8
 SEE LEVEE DE SIGN
 4 STABILITY CROSS:
 5 NEW LEVEE WAS AN
 6 "NEW"REFERS TO TH
 7 EXISTIN" EVEES W
 PRESSUME BUILD
 8 FOR SUDDEN DRAW
 SEE PARAGRAPH C

VALUE ENGINEERING PAYS

FACTOR OF SAFETY FOR SLOPE STABILITY ANALYSIS (EM 1110 -2-1913 DATED 31 MARCH 1978)

		RIVERSIDE			LANDSIDE				FACTOR OF SAFETY TABLE NOTES:		
BEACH	CROSS SECTION (Reg min FS)	EOC	W/EQ	1.0	CR/FL	W/EQ	E00	EOC W/EQ	5\$	SS W/EQ	EOC End of Construction SD Sudden Drawsown Cr./Ft Critical Flood
5	TYPICAL - EXISTING	1.8	1.7	1.5	NA	NA	1.8	1.7	NA	NA.	SS Steady Seepage
	WEAK EMBANKMENT - EXISTING	1.5	1.2	1.3	NA	NA	15	1.2	NA	NA	W/EQ Applied Earthquake Setsmic COEF +Q.15 G
	NEW-TO BE CONSTRUCTED	1.6	1.8	1.2	NA	NA	1.6	1.6	NA	NA	NA. Not Applicable



NEW LEVEE

LEGEND:

FS - FACTOR OF SAFETY

FS FACTOR OF SAFETY WITH SEISMIC COEFFICIENT

FS EDC - FACTOR OF SAFETY FOR END OF CONSTRUCTION

FS SO - FACTOR OF SAFETY FOR SUDDEN DRAWDOWN

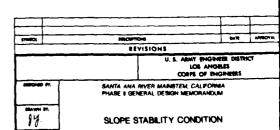
T - TYPICAL CROSS-SECTION GENERALLY REPRESENTS THE MOST COMMON SOIL CONDITIONS

-WATER SURFACE

NOTES:

- SIDE SLOPES INREACH 5 ARE CONCRETE LINED
- 2 SEE PLATE 29 FOR LEVEE DESIGN PARAMETERS.
 3 PERCENTS (90 %, 80 %) REPRESENT PERCENT RELATIVE COMPACTION USED IN ANALYSIS,
 SEE LEVEE DESIGN PARAMETERS TABLE.
- 4 STABILITY CROSS SECTIONS ANALYZED WITH IV ON 2H SIDE SLOPES
- 5 NEW LEVEE WAS ANALYZED FOR END OF CONSTRUCTION
- 6 'NEW REFERS TO THE SOIL CONDITION AFTER RECONSTRUCTION 7 EXISTING LEVES WERE ANALYZED AS STATIC CASES, I.E. WITHOUT EFFECTS OF EXCESS PORE PRESSURE BUILD UP
- 6 FOR SUDDEN DRAWDOWN CASE, SATURATED EMBANKMENT IS DUE TO HIGH GROUND WATER TABLE SEE PARAGRAPH 6-07



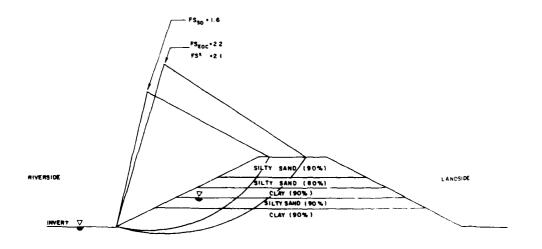


VALUE ENGINEERING P

BEACH

RIVERSIDE - LANDSIDE SAND / SILTY SAND (90%) SILT (90%) SAND / SILTY SAND (90%) SILT (90%)

SILT FOUNDATION



CLAY FOUNDATION

RIVER

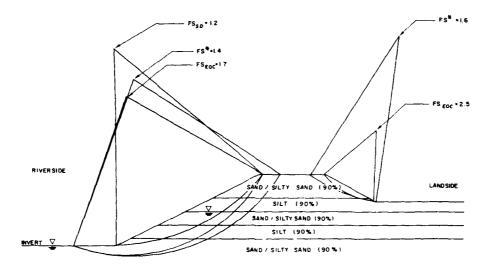
INVERT_

NOTES:

FACTOR OF SAFETY FOR SLOPE STABILITY ANALYSIS (EM 1110 -2-1913 DATED 31 MARCH 1978)

				LANDSIDE						
BEACH	CROSS SECTION	EOC	EOC W/EQ	SD	CR FL	WEQ	EOC	EDC W/EQ	SS	SS
	(Req min FS)	1.3	1.0	1.0	1.4		1.3	1.0	1.4	1.0
5	SILT FOUNDATION - EXISTING CLAY FOUNDATION - EXISTING SAND/SILTY SAND FOUNDATION- FRISTING	1.8 2.2 1.7	1.7 2.t 1.4	1.4 1.6 1.2	NA NA NA	NA Na Na	NA 22 25	NA 2 I 1 6	NA NA NA	NA NA NA

FACTOR OF SAFETY TABLE NOTES: EOC. End of Construction
SD Sudden Drawdown
Cr. / Fl. Critical Flood
SS. Steady Seepage
W/EQ. Applied Earth quake Seismic COEF +0.15 G
NA. Mot Applicable



SAND / SILTY SAND FOUNDATION

LEGEND

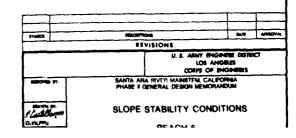
- FS FACTOR OF SAFETY WITH SEISMIC COEFFICIENT FS FACTOR OF SAFETY WITH SEISMIC COEFFICIENT FS SECTOR OF SAFETY FOR SHOOEN DRAWDOWN

 WATER SURFACE

NOTES

- SIDE SLOPES IN REACH 5 ARE CONCRETE LINED
 SEE PLATE 29 FOR LEVEE DESIGN PARAMETERS
 PERCENTS (90 %, 80 %) REPRESENT PERCENT RELATIVE
 COMPACTION USED IN ANALYSIS, SEE LEVEE DESIGN PARAMETER TABLE.
- 4. STABILITY CROSS SECTIONS ANALYZED WITH IV ON 2H SIDE SLOPES.
- END OF CONSTRUCTOR AMALYSIS WAS NOT PERFORMED ON EXISTING LEVEES:
 INSTEAD A STATIC ANALYSIS WAS PERFORMED. I.E. WITHOUT EFFECTS OF PORE
 PRESSURE BURLD UP
- FOR SUDEEN DRAWDOWN CASE, SATURATED EMBANKMENT IS DUE TO HIGH GROUND WATER TABLE SEE PARAGRAPH 6-07

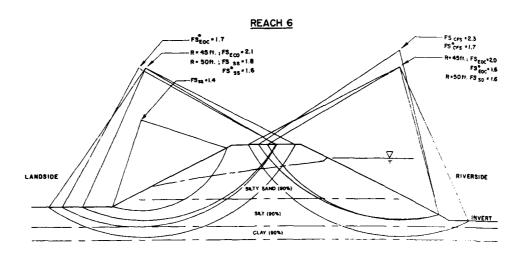
SCALE IN . 10 FT 0 0 10



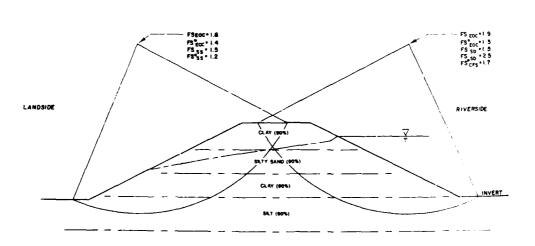
LANDSIDE

VALUE ENGINEERING P

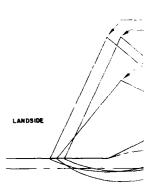
REACH C



SILTY SAND EMBANKMENT



CLAY/SAND EMBANKMENT



NOTES:

- SIDE SLOPES I SEE PLATE 2 PERCENTS (90 COMPACTION U
- STABILITY CRC
- END OF CONST INSTEAD A STA PRESSURE BUI
- FOR SUDDEN I

LUE ENGINEERING PAYS

EDC - 1.6

SIDE

HVERT

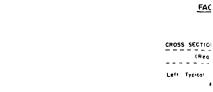
VERT

LANDS DE

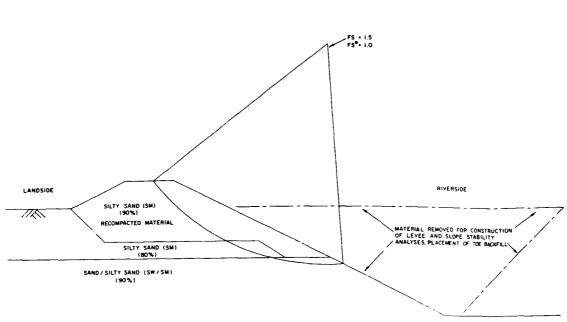
FOLLOW ON SPIELS LOW SPONE RINGER, MANORALEM "S. S. 9.7 SPIELS I MARCH BLA. MATERIAL SHEETS SHELL MATER EX. % % " 100 m 42. SET SAME SAMEOUNDER. CONTRACTOR STATES OF STATES ... 8 2 8 4 25 20 20 5 LANCE IMPERMILE. -55 exc 5 ₹40% T ---- F\$ gr 1 2 -TIP LA EVBANKMENT £iBit <u> ₹5 €3</u> REVISIONS THE SUPPLE IN MEMORY SIME CONCORDE UMED THE PURTLE AND MAY EXPER SERVICE PROCESSES OF A SUPPLEMENTARY PROCESSES AND AND A STREET OF A SUPPLEMENTARY OF A SUPPLEMENTAR TO CHOSE SECTIONS AND TREE STREET OR 29 SOE SLOPES. SHE'S AND WHEN WHISTER CALFORNIA THE OF CONTINUE OF MALE 94 MIS NOT PERFORMED IN EMPTOR LEVELS WE'LD A STORY, MAILURG MAS PERFORMED I E WITHOUT OF PECTS OF FORE PERFORMED AND A PERFORMED AND SLOPE STABILITY CONDITIONS TIO DIESTO STOUTSTON CASE SATURATES EXPERIENTED IS BUT TO HOS-STOUTS SINCE TIES, E

REACH 6 AND 7

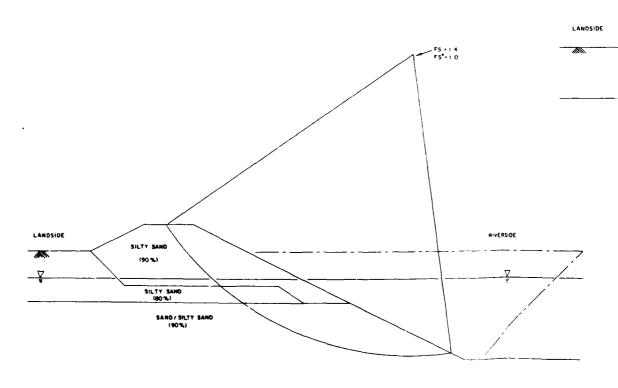
VALUE ENGINEERING PA



SILTY (F):



END OF CONSTRUCTION



CRITICAL FLOOD STAGE

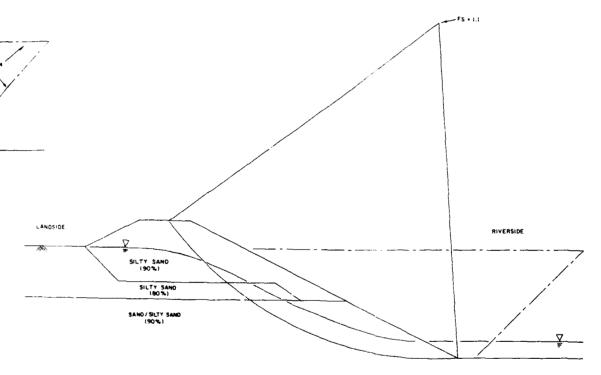
UE ENGINEERING PAYS

RSIDE

FACTOR OF SAFETY FOR SLOPE STABLITY ANALYSIS (EM IIIO - 2-1913 DATED 31 MARCH 1978)

			~ CANDSIDE				FACTOR OF S			
CROSS SECTION	EOC	EOC W/EQ	so	CR/FL-	Stoge W/EQ	EOC	EOC.	SS	S S W/EQ	EOC
(Reg min FS)	1.3	1.0	1.0	1.4	1.0	1.3	1.0	14	1.0	SD
Left Typical - New	15	1.0	1.1	1.4	10	NA	NA.	NA.		W/ EQ

AFETY TABLE NOTES End of Construction
Sudden Drawdown
Critical Flood
Steady Seepage
Applied Eerthquake Seismic COEF + 0,15G
Not Applicable



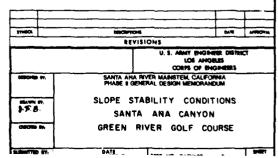
SUDDEN DRAWDOWN

LEGEND - FACTOR OF SAFETY FSS- FACTOR OF SAFETY WITH SEISMIC COEFFICIENT T - WATER SURFACE -- - TOE BACKFILL BOUNDARIES NOTES: 1. STEADY SEEPAGE CONDITION WAS NOT INCLUDED; SINCE IT IS NOT APPLICABLE. PERCENTS (80%, 80%) REPRESENT PERCENT RELATIVE COMPACTIONS USED IN ANALYSES; SEE LEVEE DESIGN PARAMETERS TABLE.

STABILITY CROSS SECTIONS ANALYZED WITH IV ON 2H SIDE SLOPES.

4. FOR DESIGN PARAMETERS TABLE SEE PLATE A-29.

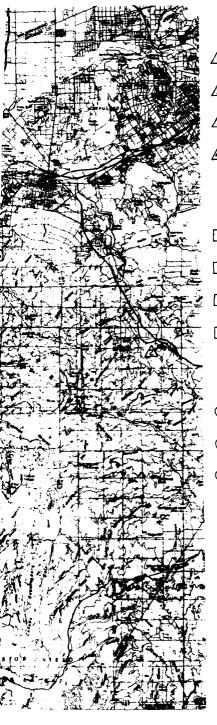
SCALE: 1 IN. . 10 FT. 10



VALUE ENGINEERING PAY



VALUE ENGINEERING PAYS



AGGREGATE SOURCES

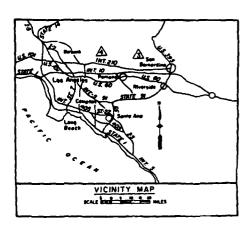
- BLUE DIAMOND MATERIALS IRVINE, CA.
- FOSTER SAND AND GRAVEL CO. CORONA, CA.
- OWL ROCK PRODUCTS CO. RIALTO, CA.
- TRANSIT MIXED CONCRETE CO. AZUSA,CA.

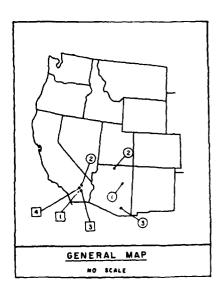
CEMENT SOURCES

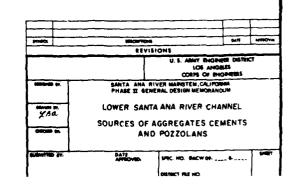
- CALIFORNIA PORTLAND CEMENT CO. COLTON, CA.
- 2 KAISER CEMENT CO. LUCERNE VALLEY, CA.
- 3 RIVERSIDE CEMENT CO. RIVERSIDE, CA.
- SOUTHWEST CEMENT CO. VICTORVILLE, CA.

POZZOLAN SOURCES

- 1 PHOENIX CEMENT JOSEPH CITY, AZ.
- ② WESTERN ASH CO. PAGE, AZ.
- 3 WESTERN ASH CO. COCHISE, AZ.







A GEOTECHNICAL

ATTACHMENT

DEPARTMENT OF THE ARMY SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS LABORATORY



LOWER SANTA ANA RIVER

REPORT OF SOIL TESTS

EDITED

SAUSALITO, CALIFORNIA

January 1980

REPORT OF SOIL TESTS

LOWER SANTA ANA RIVER

JANUARY 1980

AUTHORIZATION

- 1. Results of tests reported herein were requested by the Los Angeles District in laboratory request No. CIV-80-12 dated 29 October 1979 and change order No. 1 dated 28 November 1979.
- 2. Three undisturbed and eight disturbed samples were received on 7 September 1979. Identification of the samples are shown on the Test Result Summary, plate 1.

TESTING PROGRAM

3. The program was in general accordance with the test request and included compaction, classification, specific gravity, direct shear, "R" triaxial compression, consolidation and permeability.

TEST METHODS

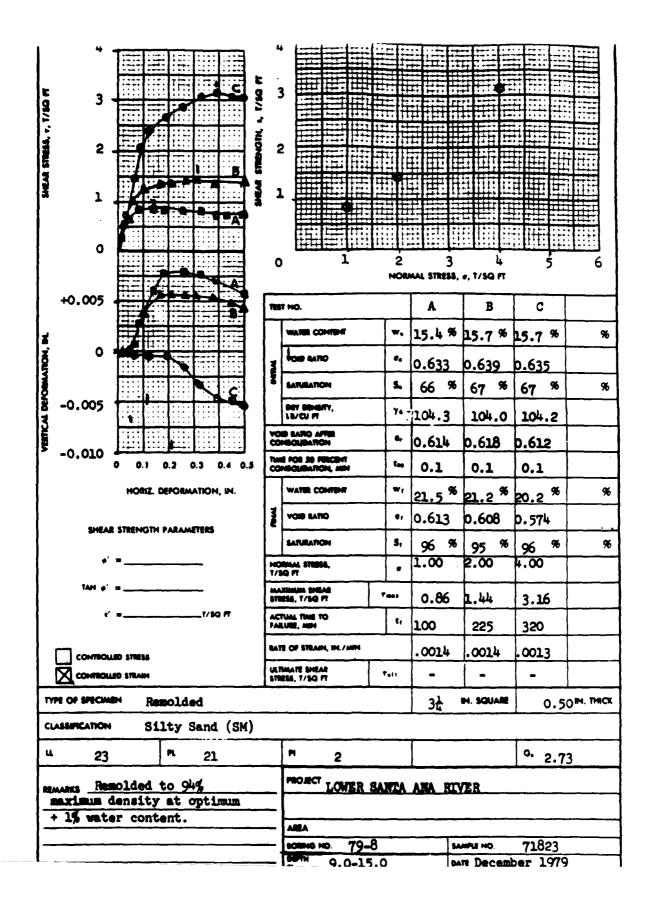
- 4. a. Grain-size Ananlysis, Atterberg Limits, Specific Gravity, Compaction, Permeability, Direct Shear, Triaxial Compression and Consolidation. Testing methods conformed to the procedure described in Engineer Manual, EM 1110-2-1906, "Laboratory Soil Testing," 30 November 1970.
- b. Classification. The soil was classified in accordance with "The Unified Soil Classification System," TM No. 3-357, Appendix A, April 1960.

RESULTS

5. Results of tests are shown on the following plates:

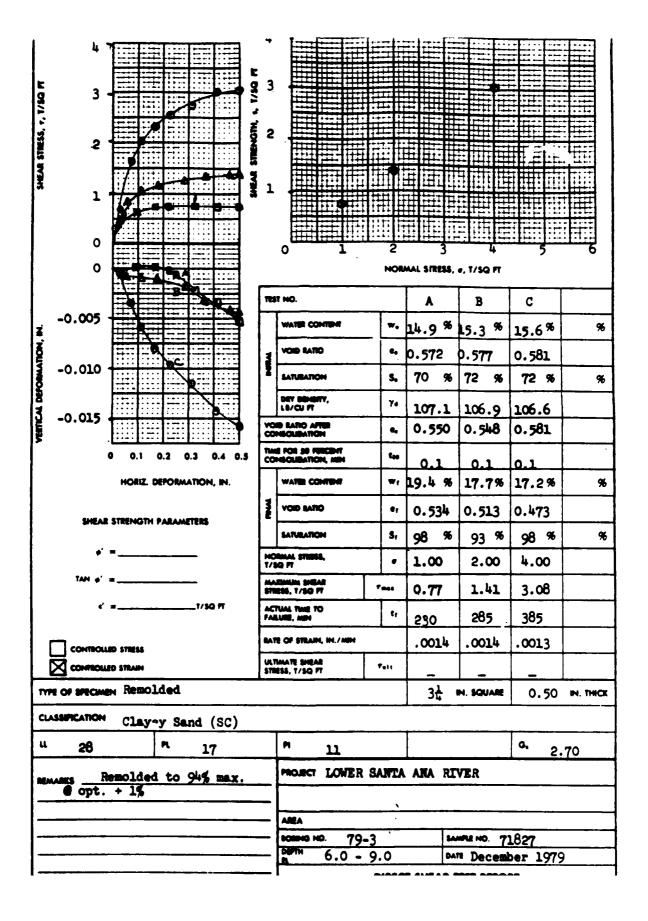
SUBJECT	PLATE NO.
Soil Test Result Summary	1
Plasticity Chart	2
Compaction Test Report	3 - 6
Direct Shear Test Report	7 - 11
Triaxial Compression Test Report	12 - 23
Consolidation Test Report	23 - 35
Permeability	36

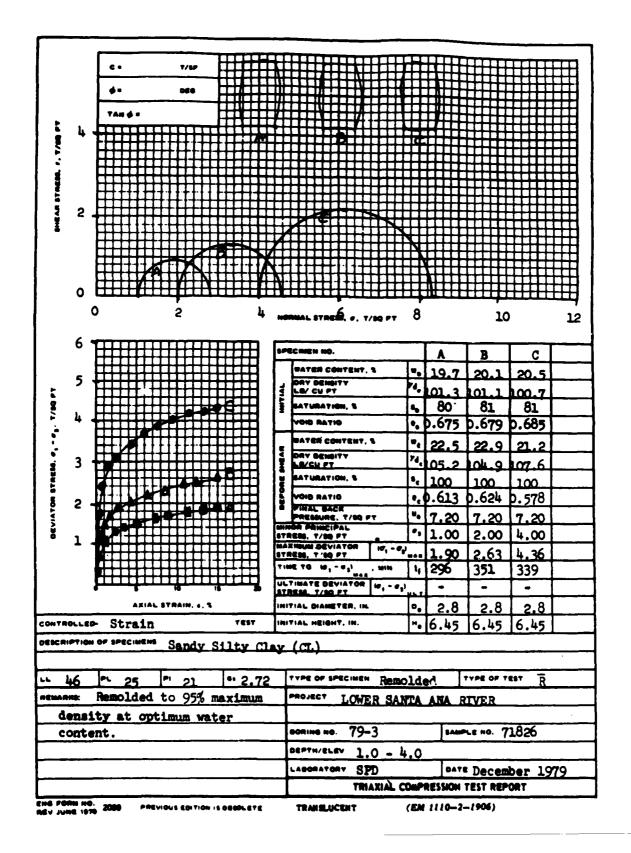
3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	TEST HO. WATER CO. W	2	2	3 AAL STRESS,			
	TES				ъ	С	
0		WATER CONTENT	₩.	A 19.7%	B 19.6%	19.6%	%
-0.01	3	VOID RATIO	0,	0.744	0.740	0.745	
	1	SATURATION	S.	73 %	73 %	72 %	%
-0.02 C		DRY DENSITY, LB/CU PT	γ4	98.1	98.3	98.0	
	8		4	0.717 0.700		0.686	
0 0.1 0.2 0.3 0.4 0.5		MOUDATION, MIN	Eq.	0.1	0.1	0.1	
HORIZ. DEPORMATION, IN.		WATER CONTENT	₩1	26.3% 24.6%		23.2%	%
SHEAR STRENGTH PARAMETERS	1	VOID RATIO	*1	0.721	0.674	0.636	~
* =		GMAL STRESS,	S,	100 %	100 %	100 %	%
TAM 6' =	-	MINUM SPEAS	7000	1.00	2.00	4.00	
e' =1/9Q FT	AC	TUAL TIME TO	.,	0.65	1.41	2.75	
	\vdash	E OF STRAIN, IN./MIN	Ц	170	.0015	.0014	
CONTROLLED STRESS CONTROLLED STRAIN	ULT	TMATE SHEAR ESS, T/SQ PT	Full	-0015	0015		
TYPE OF SPECIMEN Remolded				31	N. SQUARE	0.50	IN. THICK
CI ACCIDICATION							
		M 13				o. 2.	74
REMARKS Remolded to 95% maximum		PROJECT LOWER	SAN	TA ANA	RIVER		
density at optimum water con- tent.	<u></u>						
	_	SOSTIG NO. 79-9		SA	MPLE NO	71822	

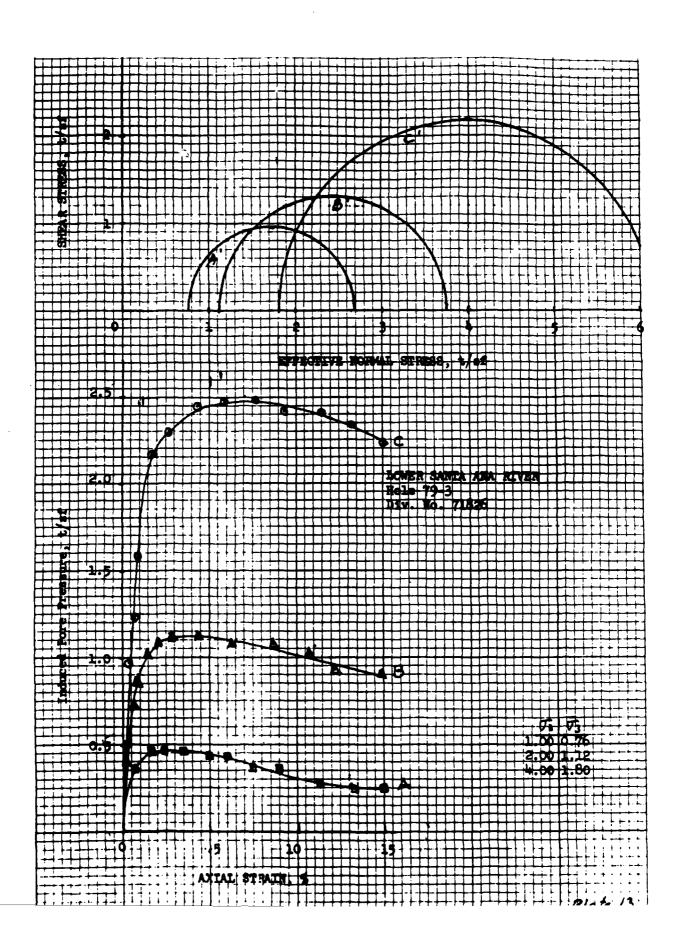


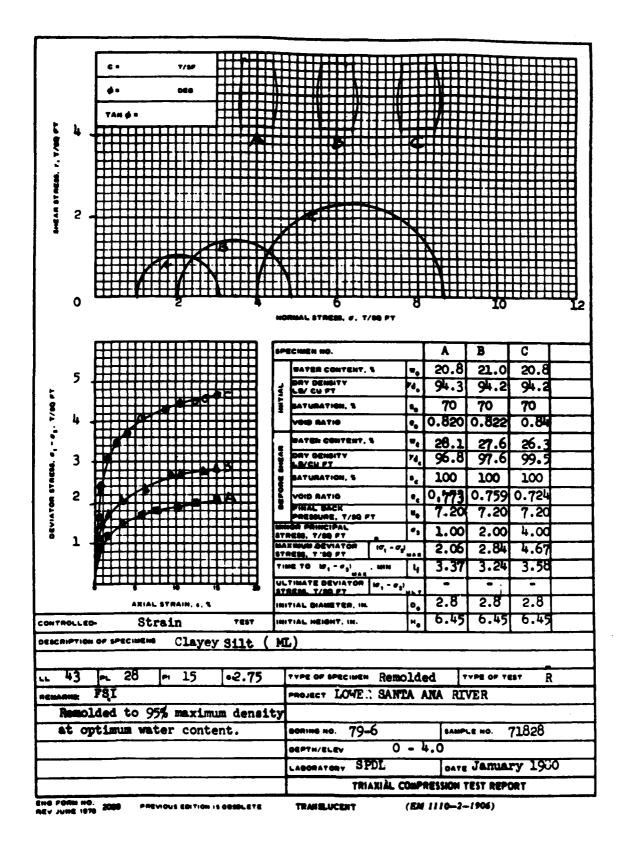
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SHEAR	-1					7	1									
	0					ſ				2 NON	MAL STRESS,	e, 1/50 FT	5			
						-	TEST N	IO. MARIE CONTRA		Τ_		В	С			
Z	-0.01 ·					1	\vdash	ORD BATTO		*•	21.2 %	19.7 %	20.4 %	%		
MATIO						┋┝	ATURATION		6.	0.755	0.737	0.745				
VERTICAL DEFORMATION,	-0.02						9	LY DENGITY,		S	77 %	73 %	75 %	%		
1 2				:::: >		VOID BATTO AFTER		98.0								
Ž	TIME FOR SO PRICE				•	0.726	0.691	0.687								
		0 0.1 0.2 0.3 0.4 0.5 HORIZ. DEFORMATION, IN.				ľ	COMSOLIBATION, MIN			Coo	0.1	0.1	0.1			
		HORIZ.	DEPORMA	ATION, IP	6.		. -	ATER CONTEM		w ,	25.6 [%]	22.9 %	22.2 %	%		
	SHEAR	STRENGTH	PARAME	TERS			╸	OID RATIO		•1	0.701	0.628	0.610			
	•'	=		_		<u> </u>	SATURATION MORMAL STRESS.			Sı	100 %	100 %	100 %	%		
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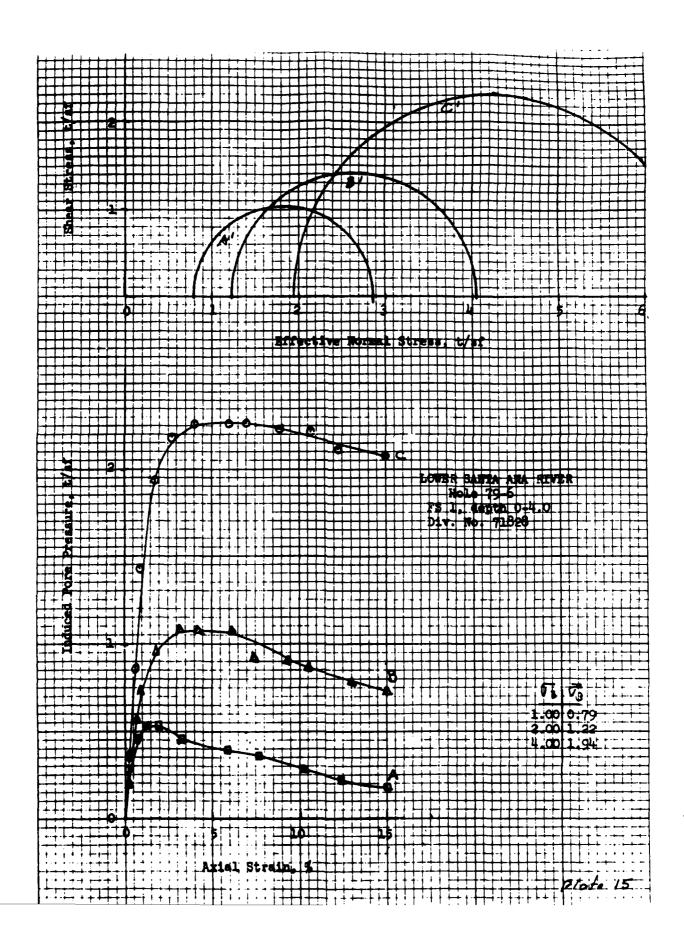


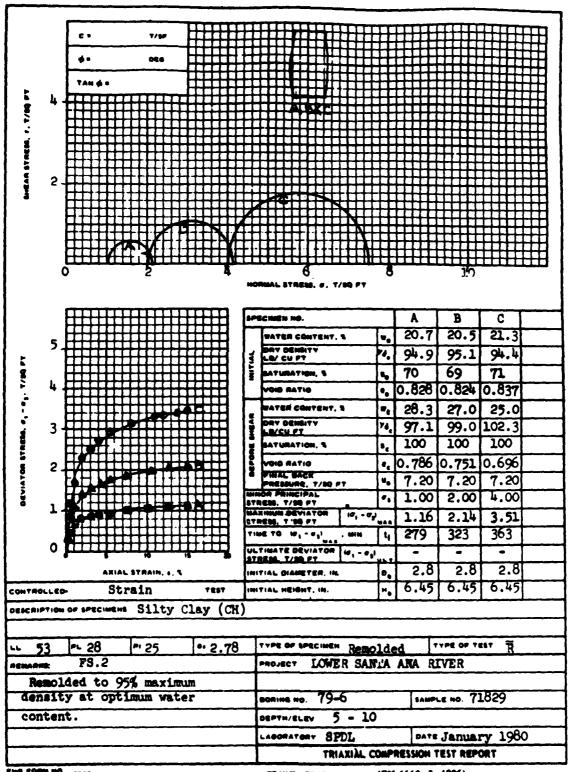


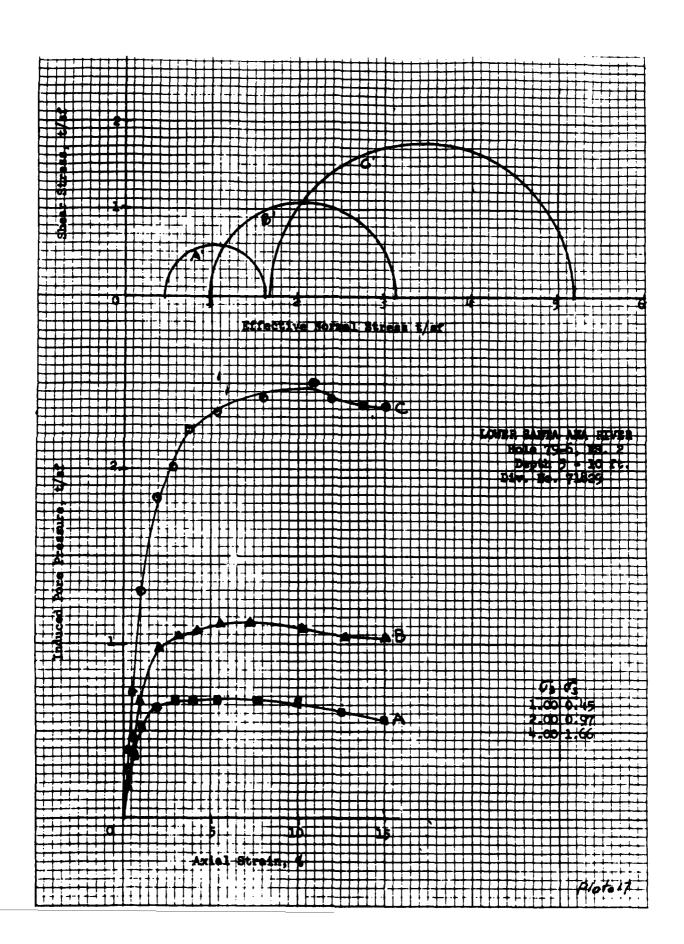




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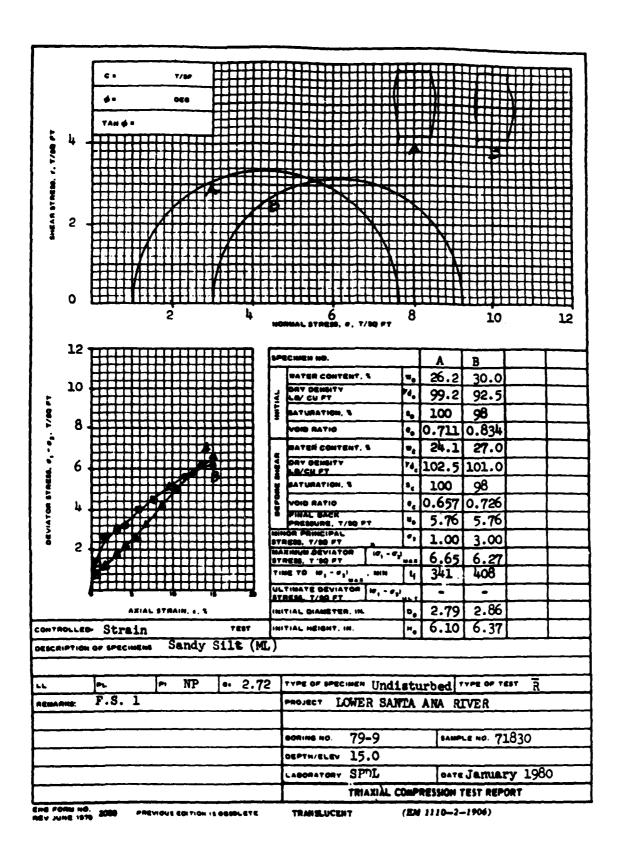
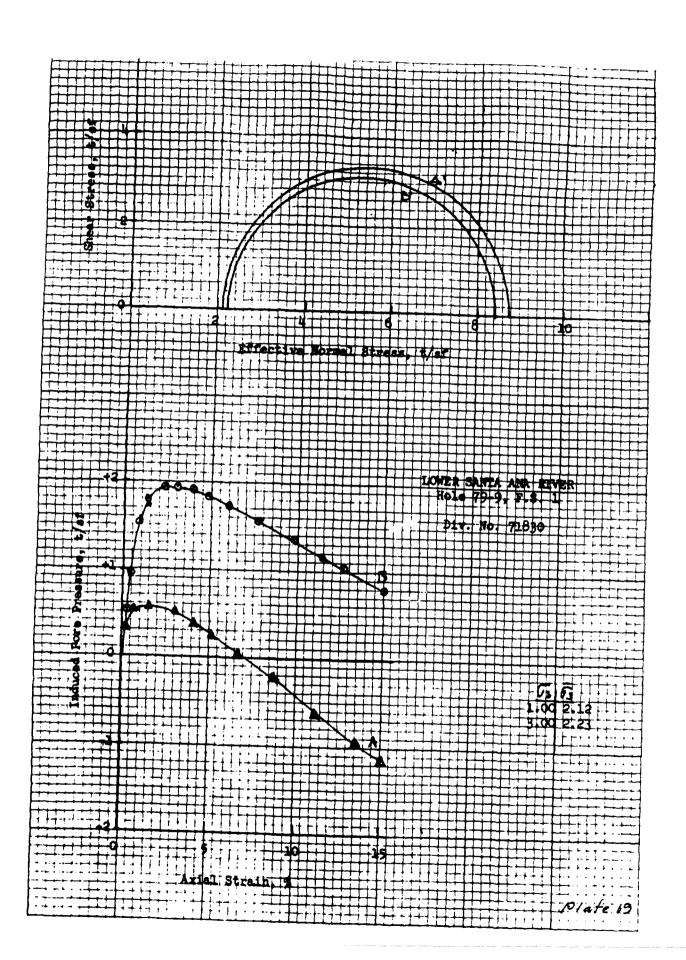
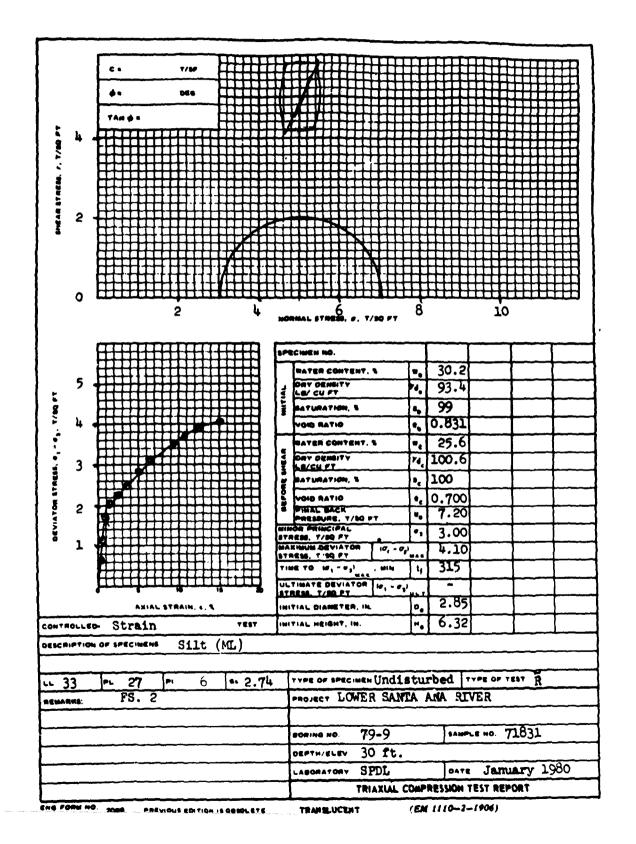
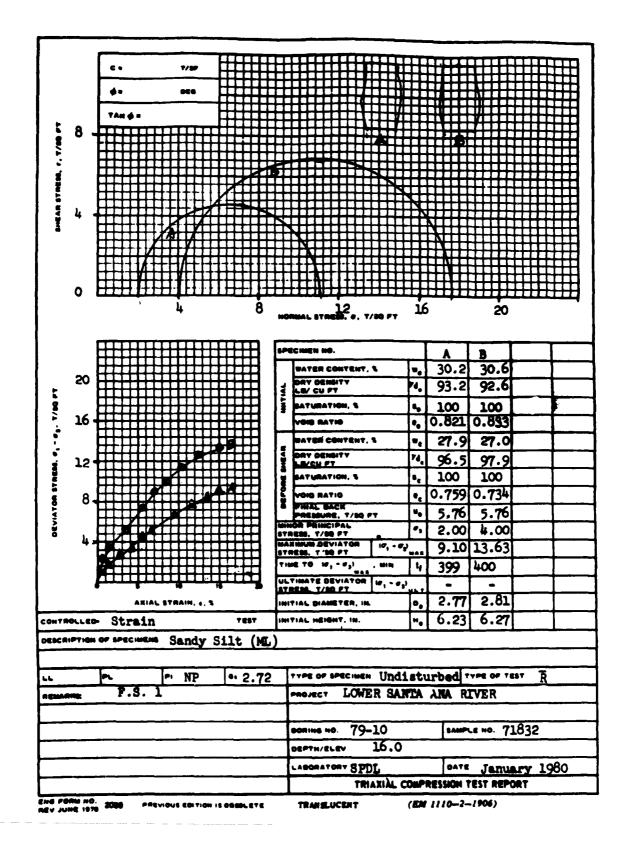
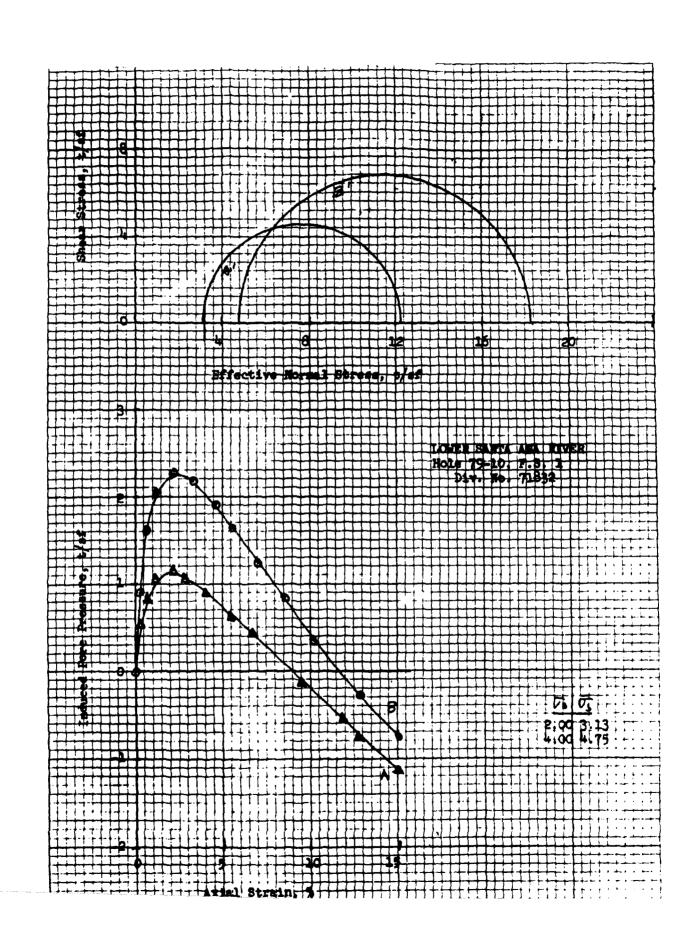


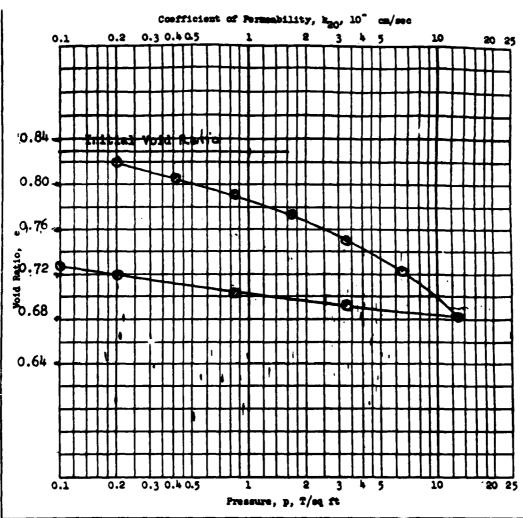
Plate 18



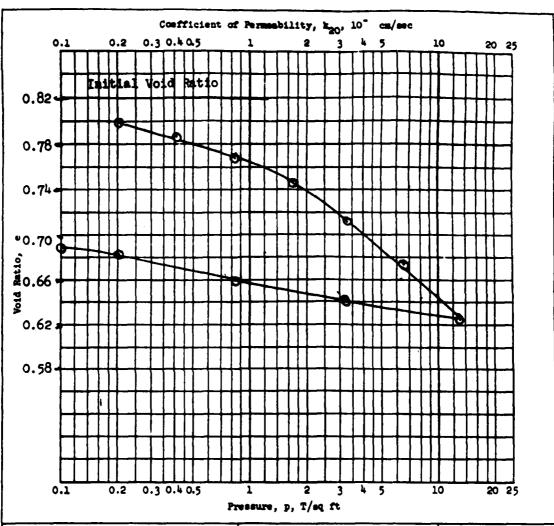




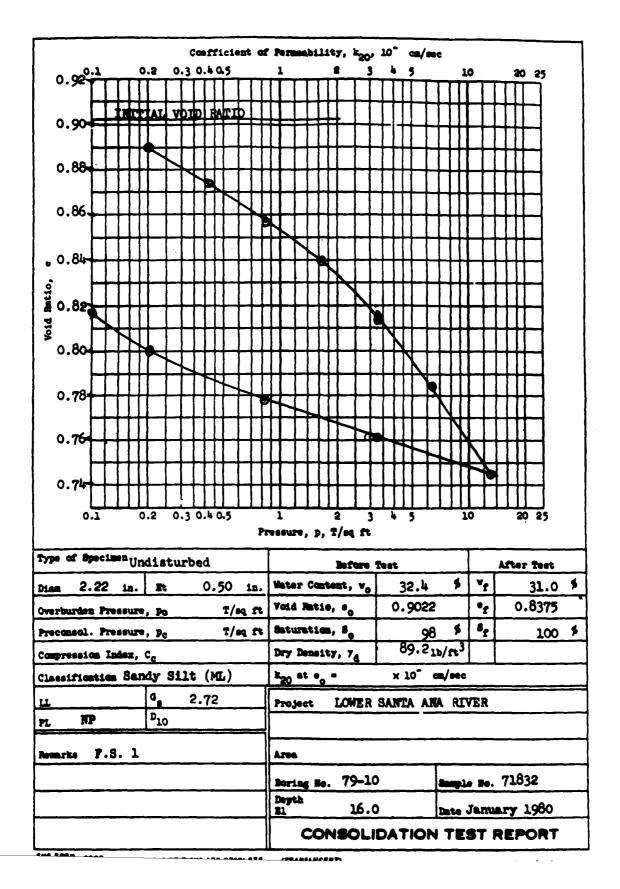


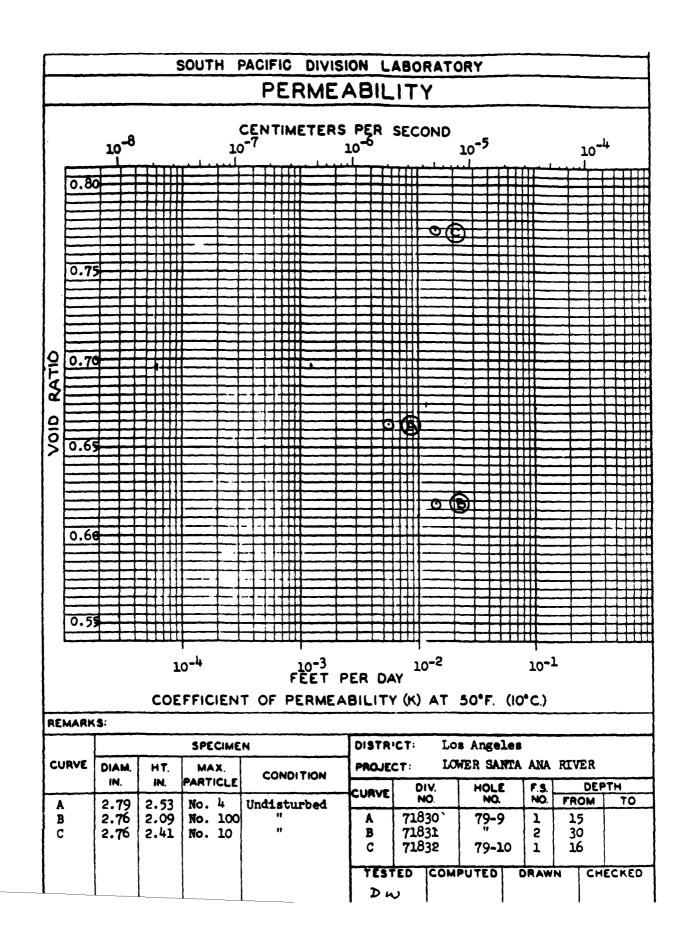


Type of Specimen Undisturbed	Before		After Test									
Diam 2.22 in. Rt 0.50 in.	Water Content, vo	29.4	V _E	28.0	*							
Overburden Pressure, po T/sq ft	Void Patio, o	0.830	•2	0.762	•							
Precensel. Pressure, pc T/sq ft	Seturation, S	96 1	Sg	100	\$							
Compression Index, Co	Dry Density, 7 _d	92.716/2	3									
Classification Sandy Silt (ML)	k ₂₀ at e ₀ = × 10° cm/sec											
LL 0 2.72	Project LOWER	Santa ana i	UVER									
PL NP D ₁₀												
Remarks F.S. 1	Ares											
	Boring No. 79-9	Sea	le No.	71830								
	Depth 15.0 Inte Jamery 1980											
	CONSOLIDATION TEST REPORT											



Type of Specimen Undisturbed	Before	After Test									
Diam 2 22 in. Ht 0.50 in.	Water Content, vo	29.7	v _f	25.4	*						
Overburden Pressure, po T/sq ft	Void Ratio, e	0.820	•r	0.693							
Preconsol. Pressure, pc T/sq ft	Saturation, So	99 🛊	Sf	100	*						
Compression Index, Cc	Dry Density, 7d	93.91b/m³									
Classification Silt (ML)	k ₂₀ at e ₀ = × 10° cm/sec										
ц. 33 с. 2.74	Project LOWER SA	NTA ANA RIVE	R								
n 7 D ₁₀											
Remrks	Area										
	Boring No. 79-9	Samp l	e No.	71831	_						
	Depth 30.0 Date December 1979										
	CONSOLIDATION TEST REPORT										





DEPARTMENT OF THE ARMY (SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS LABORATORY



REPORT OF SOIL TESTS

SANTA ANA RIVER

EDITED

SEPTEMBER 1983

SAUSALITO, CALIFORNIA

REPORT OF SOIL TESTS

SANTA ANA RIVER

SEPTEMBER 1983

AUTHORIZATION

1. Results of tests reported herein were requested by the Los Angeles District in laboratory request No. CIV-83-108 dated 20 July 1983.

SAMPLES

2. Thirteen undisturbed tube samples and 17 sack samples were received on 21 June and 25 July 1983. Identification of samples is on the Soil Test Result Summary, plates 1 and 2.

TESTING PROGRAM

3. The program was in accordance with the test request and verbal instructions from Mr. C. Sands/SPLED-GD, and included laboratory classification tests, triaxial shear, field unit weight, and compaction tests.

TEST METHODS

- 4. a. <u>Grain-size Analysis</u>, <u>Atterberg Limits</u>, <u>Compaction</u>, <u>Specific Gravity</u>, <u>Field Unit Weight</u>, <u>and Triaxial Compression</u>. Testing methods conformed to the procedures described in Engineer Manual, <u>EM 1110-2-1906</u>, "Laboratory Soil Testing", 30 November 1970.
- b. Classification. The soils were classified in accordance with the "Unified Soil Classification System", TM 3-337, Appendix A, April 1960, reprinted May 1967.

RESULTS

5. Results of tests are shown on the following plates:

Subject	Plate No.
Soil Test Result Summary	1 - 2
Plasticity Chart	3 - 4
Compaction Test Report	5 - 14
Triaxial Test Report	
Undisturbed	15
Remolded	16 - 19

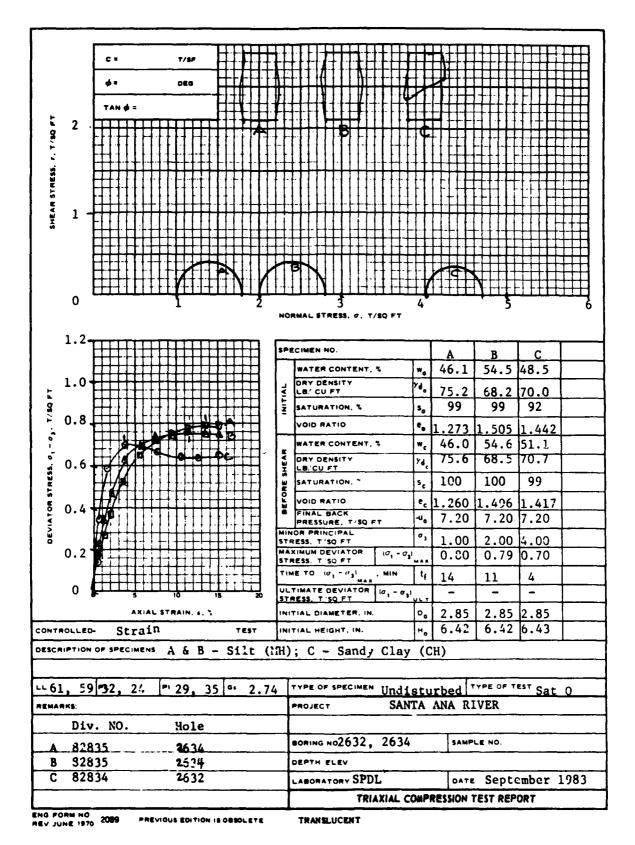
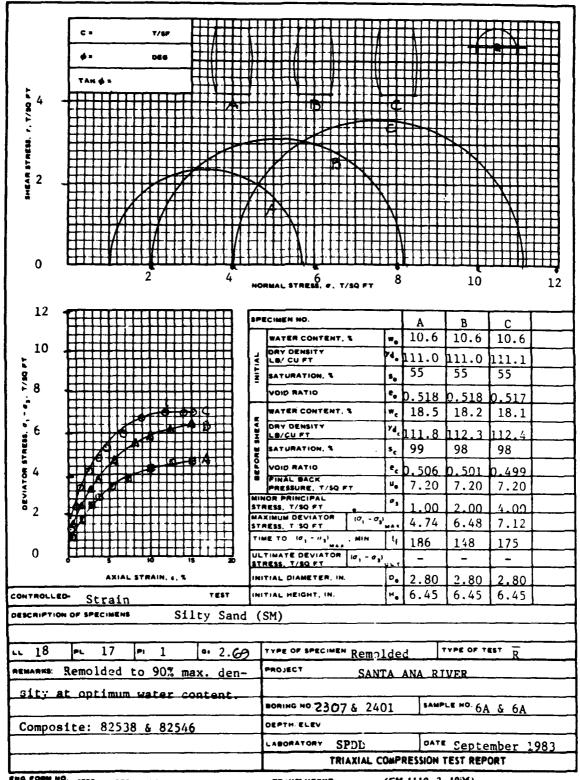


plate 15

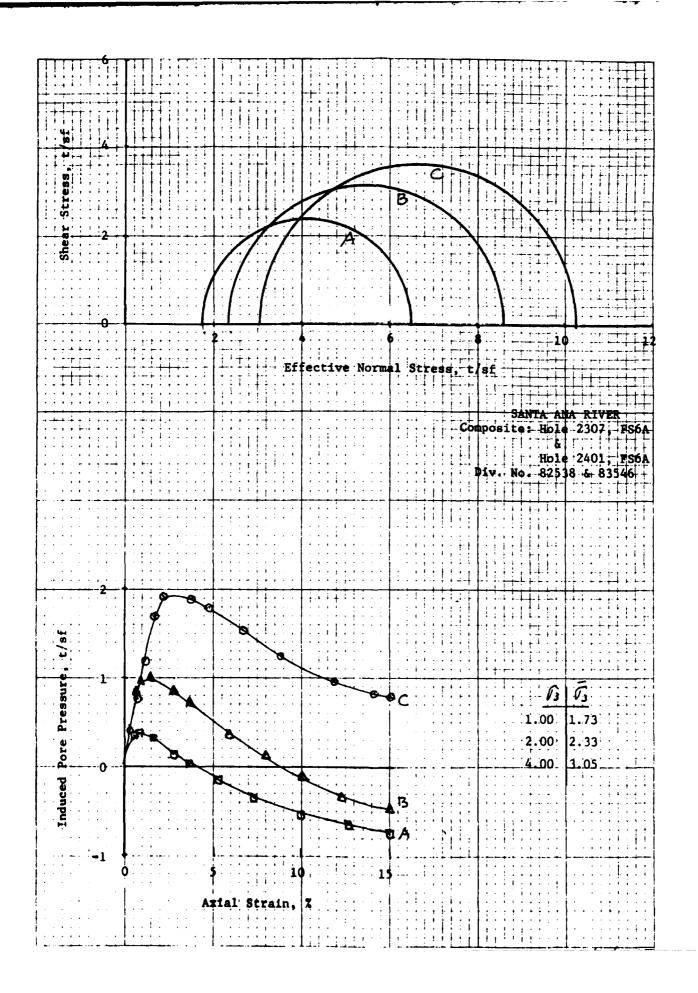


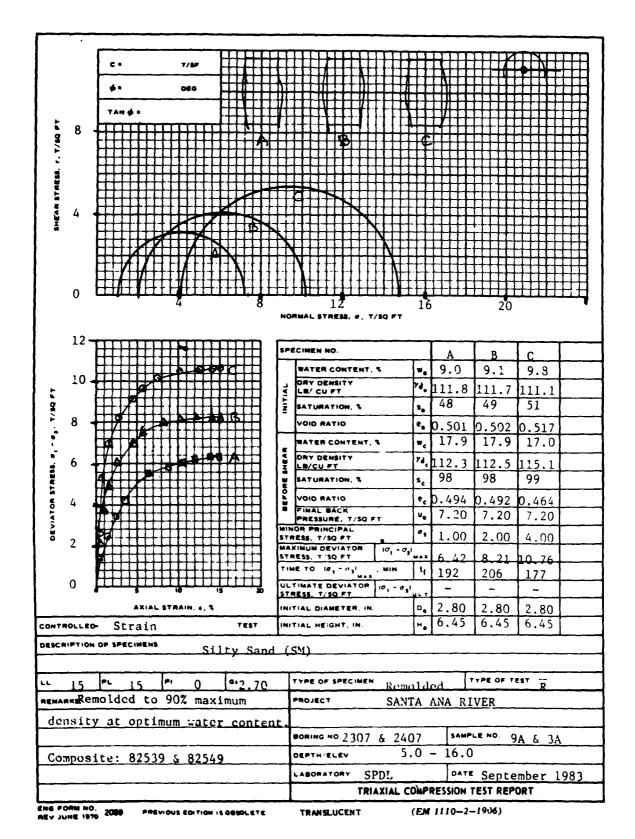
ENG FORM NO. REV JUNE 1970 2009

PREVIOUS EDITION IS GESOLETE

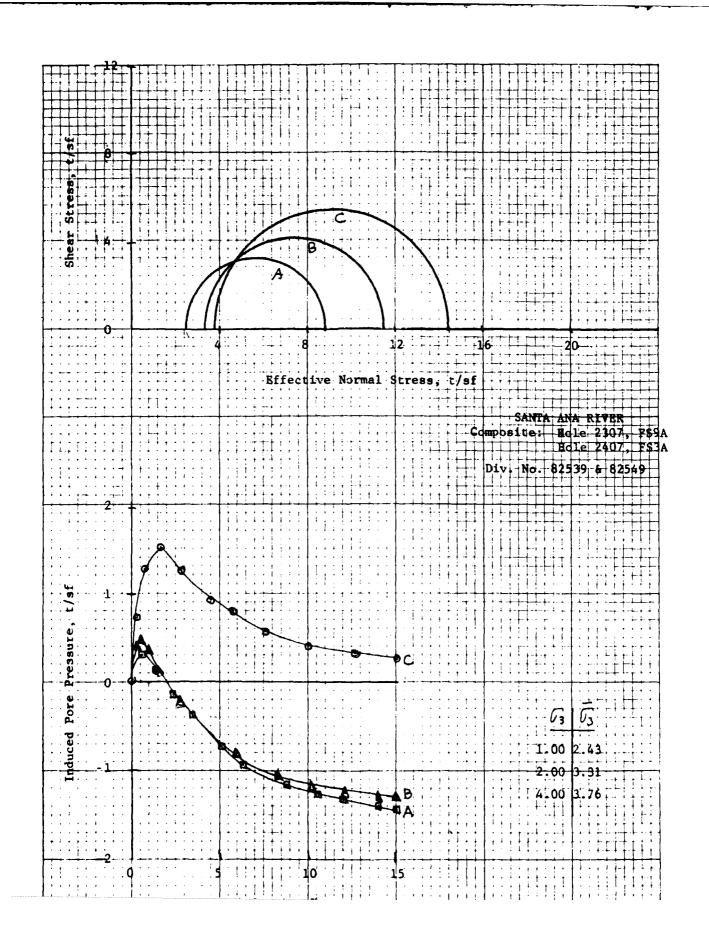
TRANSLUCENT

(EM 1110-2-1906)





plates 18



DEPARTMENT OF THE ARMY SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS LABORATORY



REPORT OF SOIL TESTS

LOWER SANTA ANA RIVER

EDITED

December 1985

SAUSALITO, CALIFORNIA

REPORT OF SOIL TESTS

LOWER SANTA ANA RIVER

December 1985

AUTHORIZATION

1. Results of tests reported herein were requested by the Los Angeles District in laboratory request No. E86-85-0057 dated 14 March 1985.

SAMPLES

2. Twenty-two undisturbed samples in brass and plastic tubes were received on 17 January 1985. Twenty-six disturbed samples in sacks were received on 25 March 1985. Identification of samples is on the Soil Test Result Summary, plates 1-2 and 36-37.

TESTING PROGRAM

3. The program was in accordance with the test request and included laboratory classification tests, unit weight, unconfined compression, direct shear, consolidation, triaxial shear and compaction.

TEST METHODS

- 4. a. Grain-size Anlaysis, Atterberg Limits, Unit Weight, Compaction,
 Specific Gravity, Triaxial Compression, Unconfined Compression, and
 Consolidation. Testing methods conformed to the procedures described in
 Engineer Manual, EM 1110-2-1906, "Laboratory Soil Testing", 30 November 1970.
- b. <u>Classification</u>. The soils were classified in accordance with the "Unified Soil Classification System", TM 3-337, Appendix A, April 1960, reprinted May 1967.

RESULTS

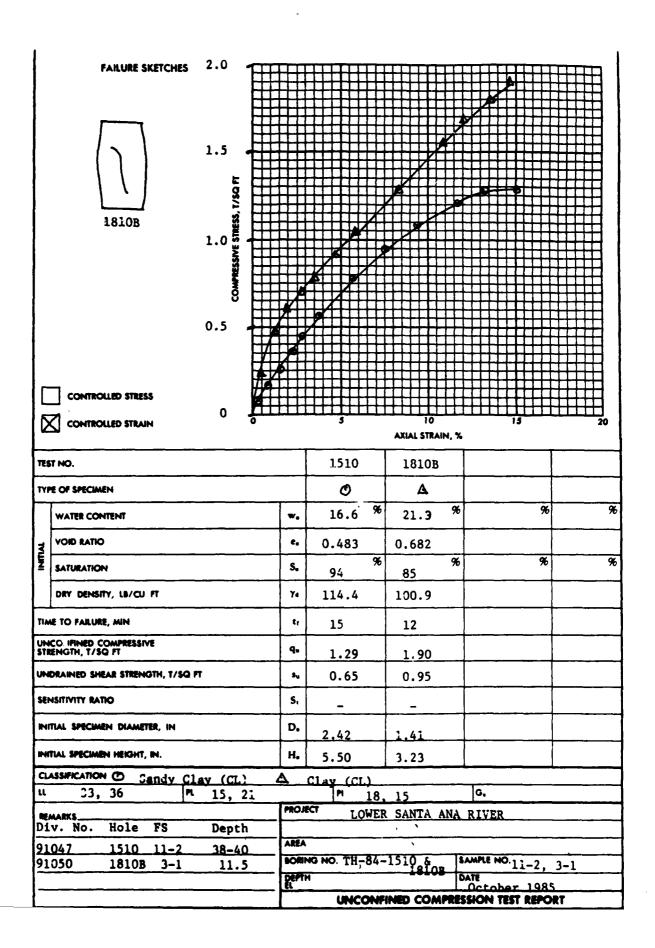
5. Results of tests are shown on the following plates:

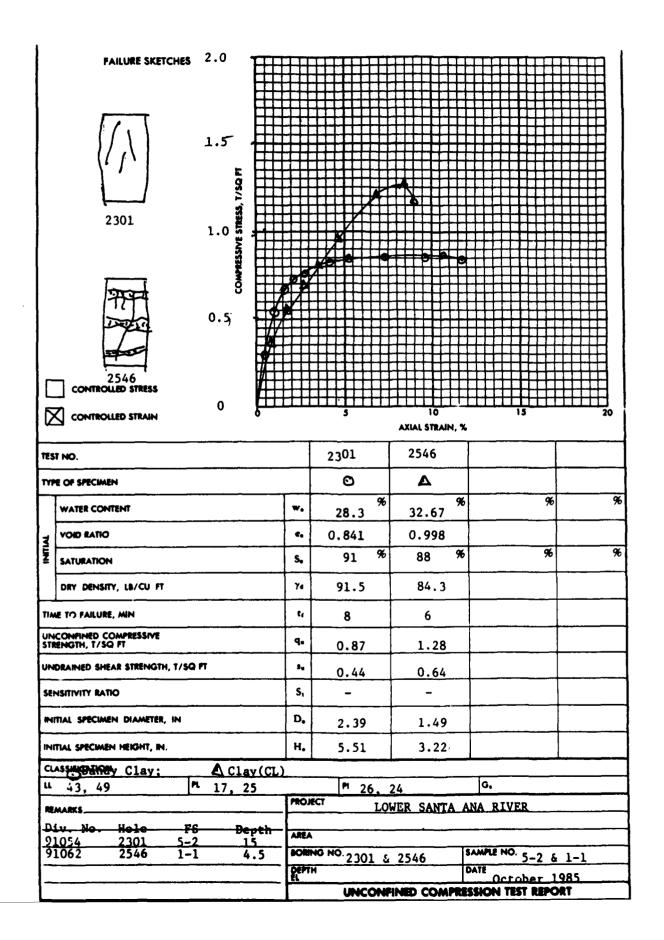
Subject	Plate No.
Undisturbed samples:	
Soil Test Result Summary	1-2
Field Unit Weight Summary	3
Unconfined Compression Test Report	4-6
Triaxial Compression Test Report	7-19
Consolidation Test Report	20-35

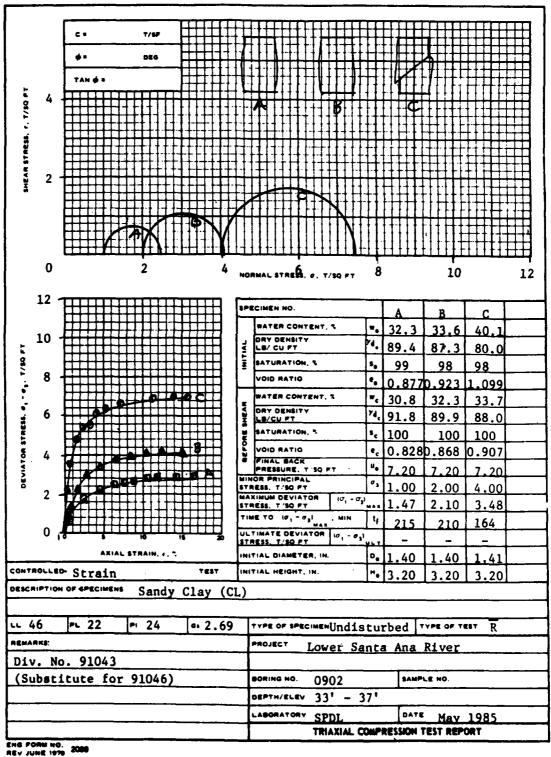
<u>Subject</u>	Plate No.
Disturbed Samples:	
Soil Test Result Summary Gradation Curves	36-37 38-39
Compaction Test Report Triavial Compression Test Repport	40-43 44-61

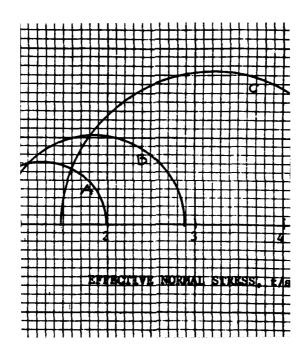
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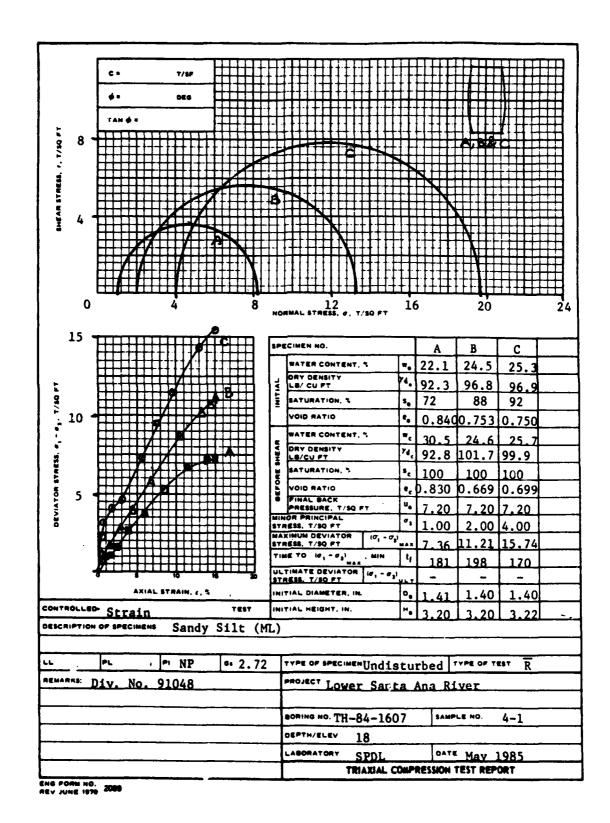
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	FAILURE SKETCHES	0																
		COMPRESSIVE STRESS, T/SQ FT																
	CONTROLLED STRESS	2																
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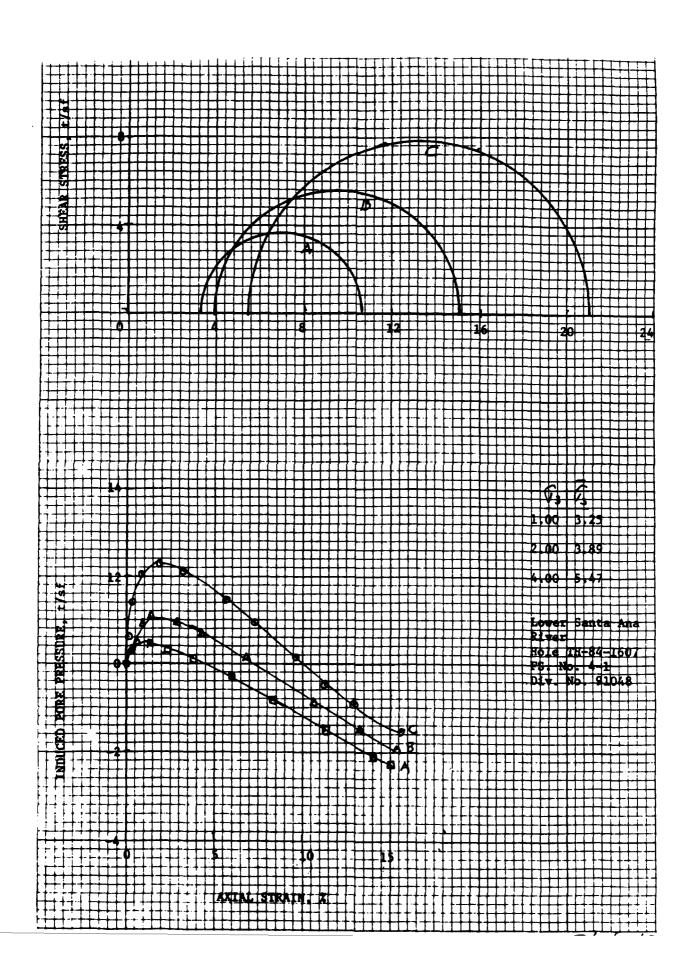


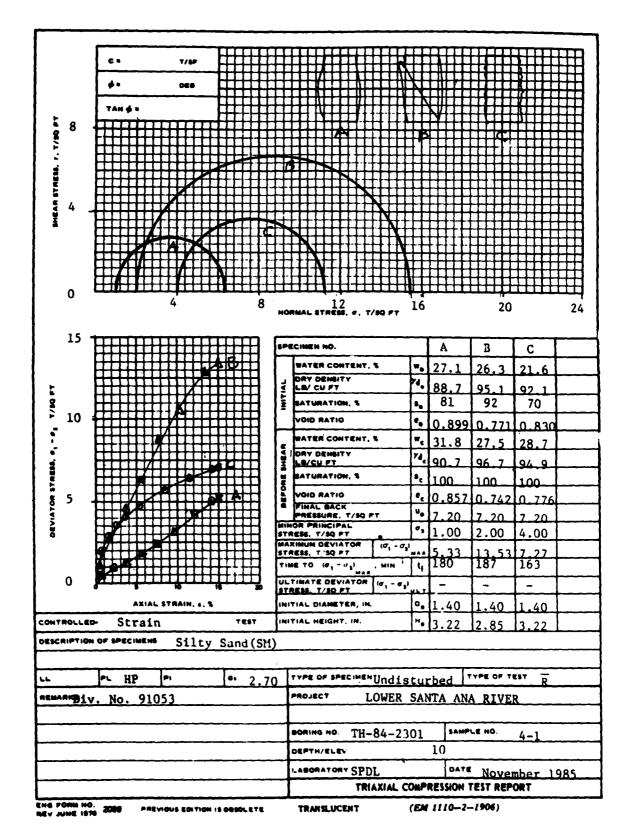




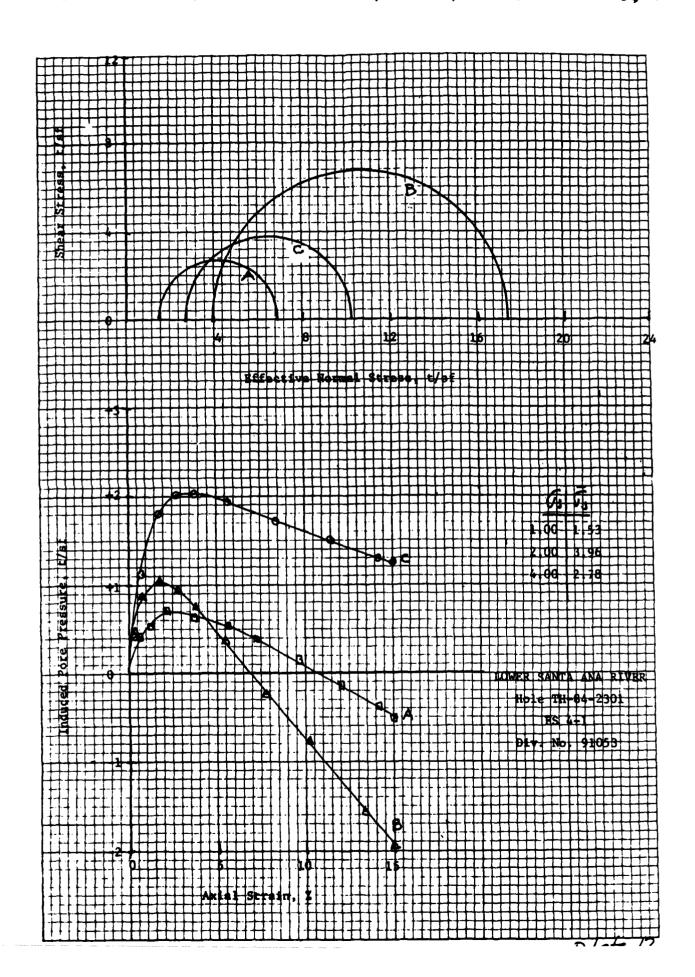








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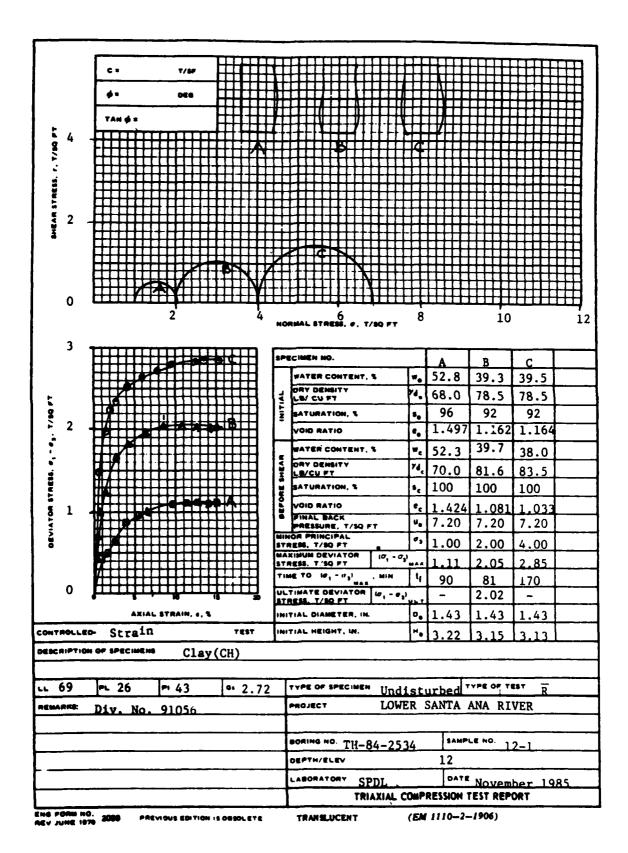
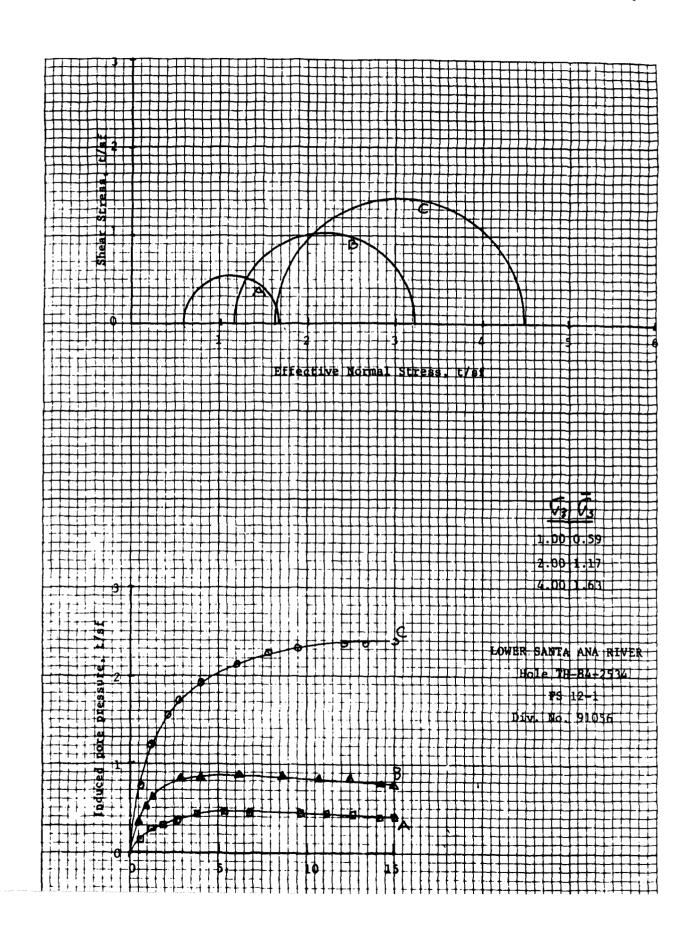
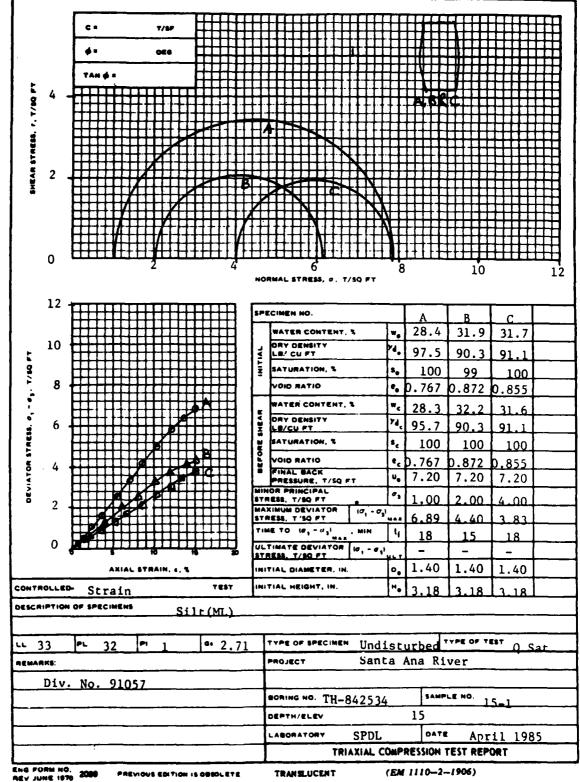
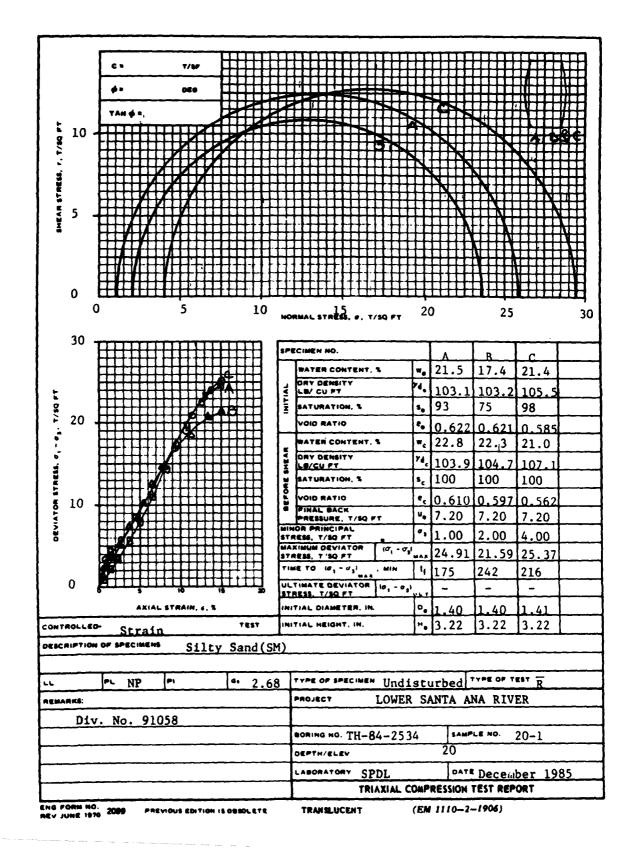
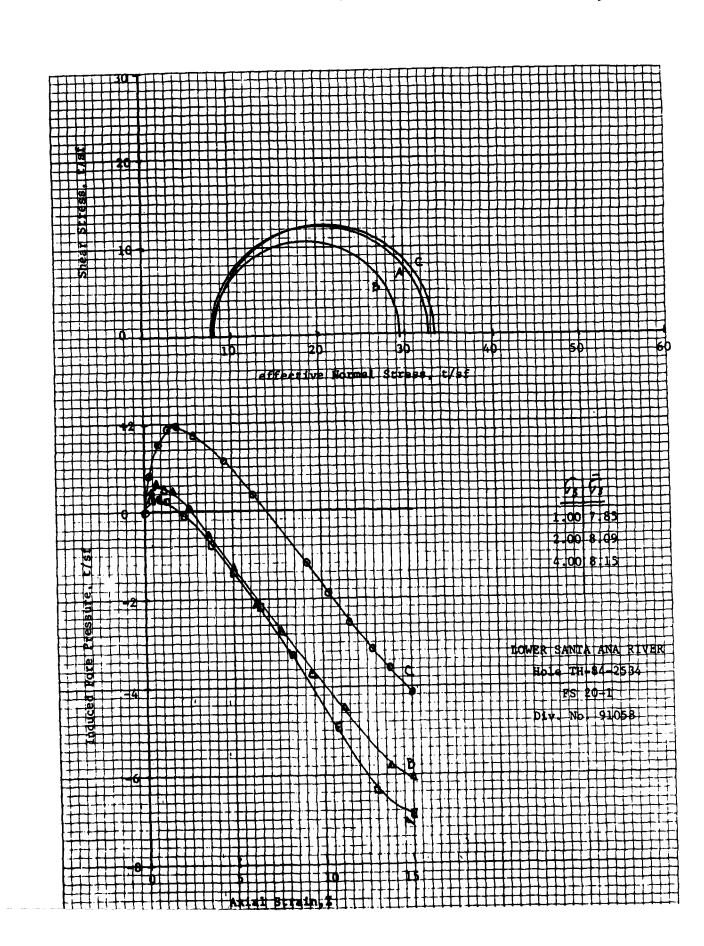


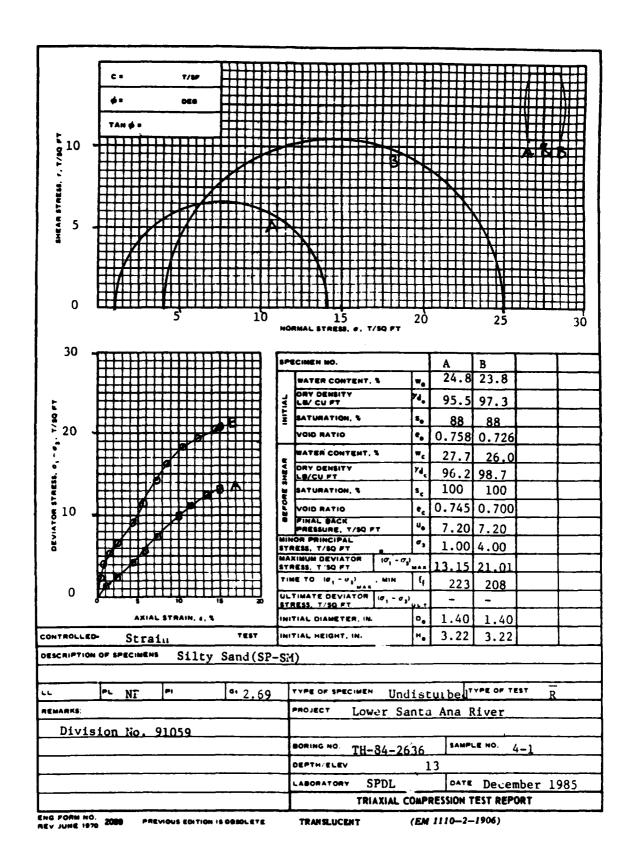
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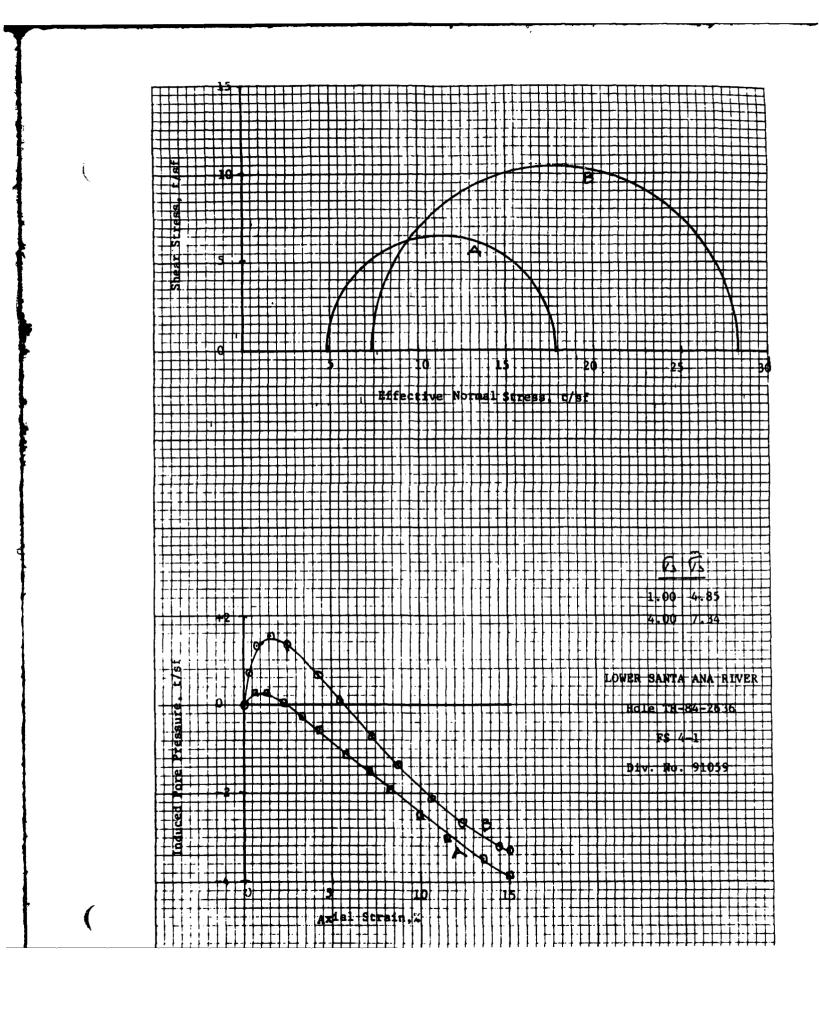


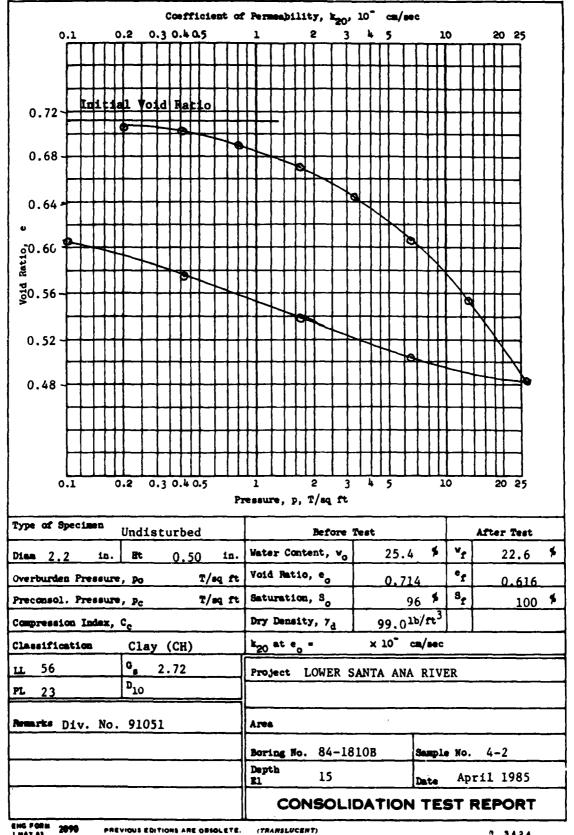




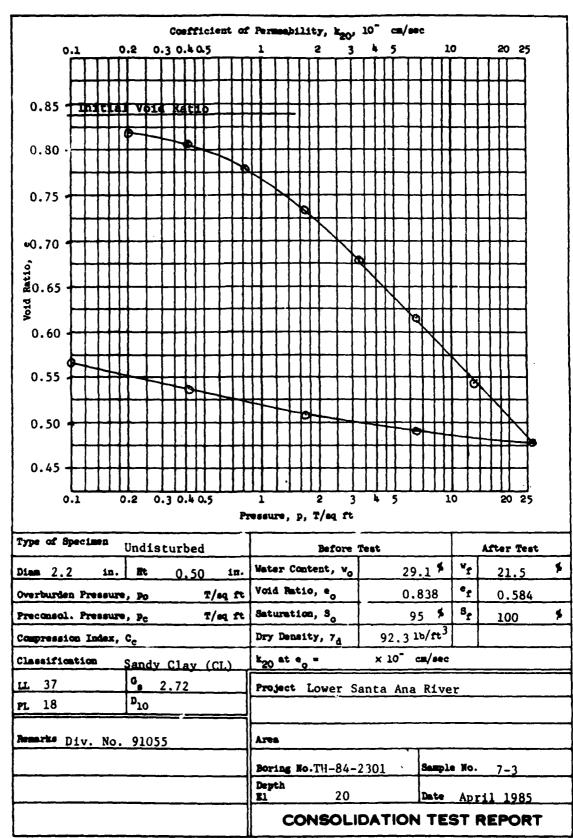


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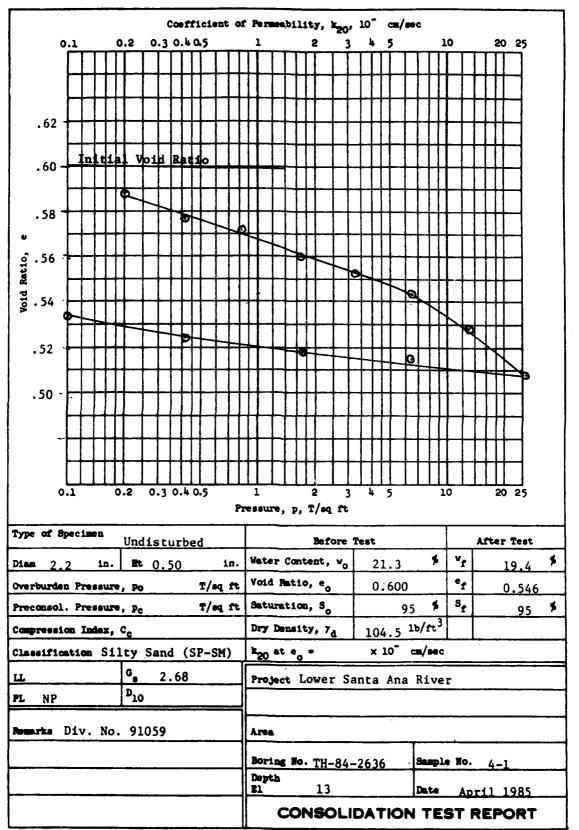




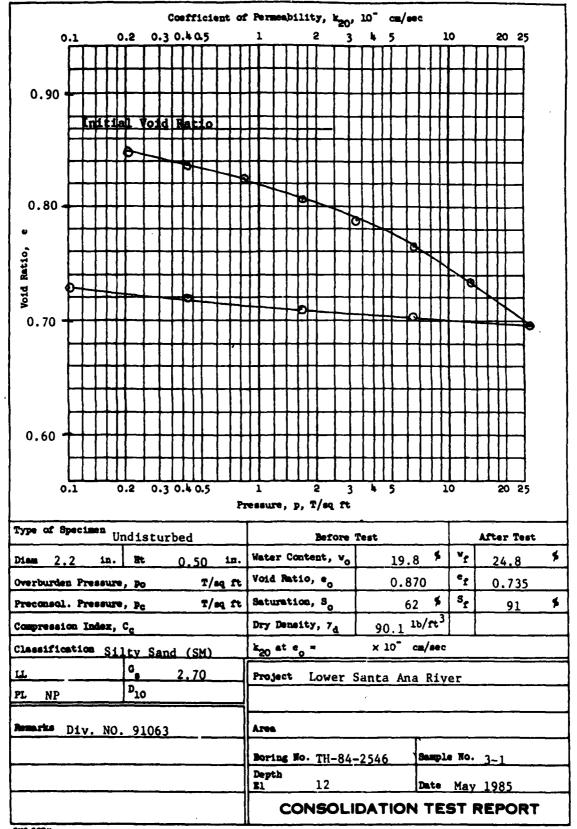
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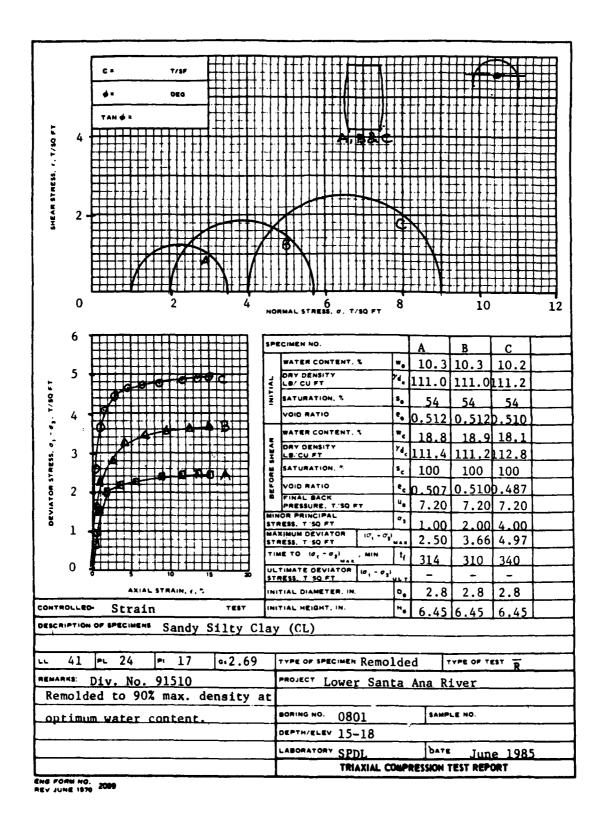
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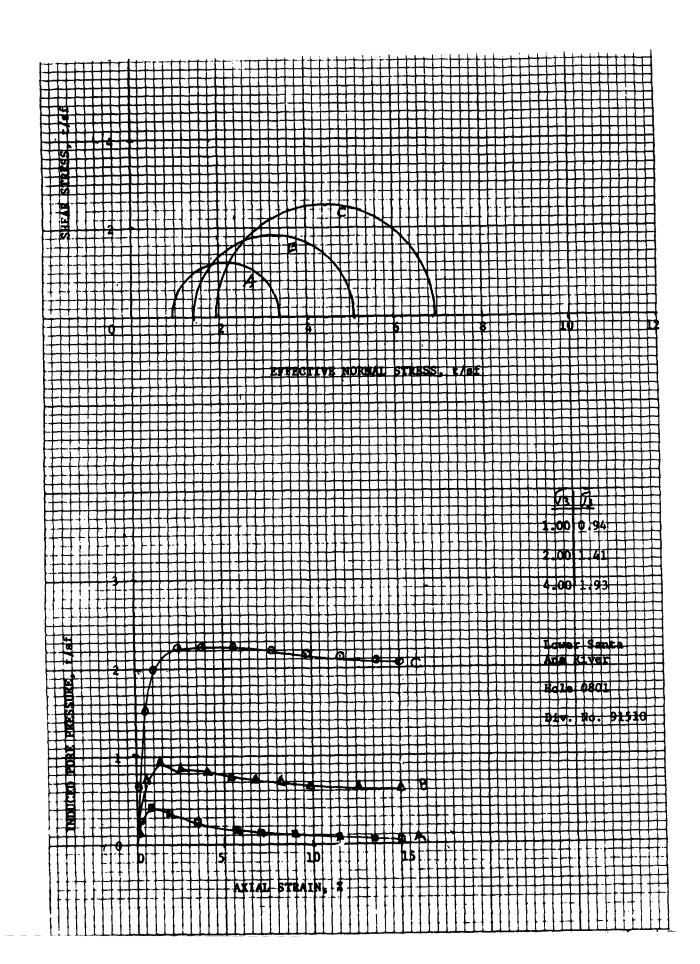


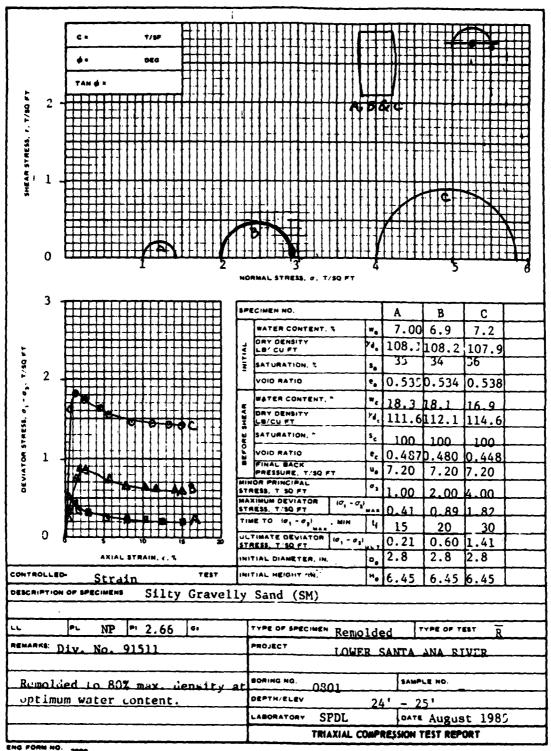
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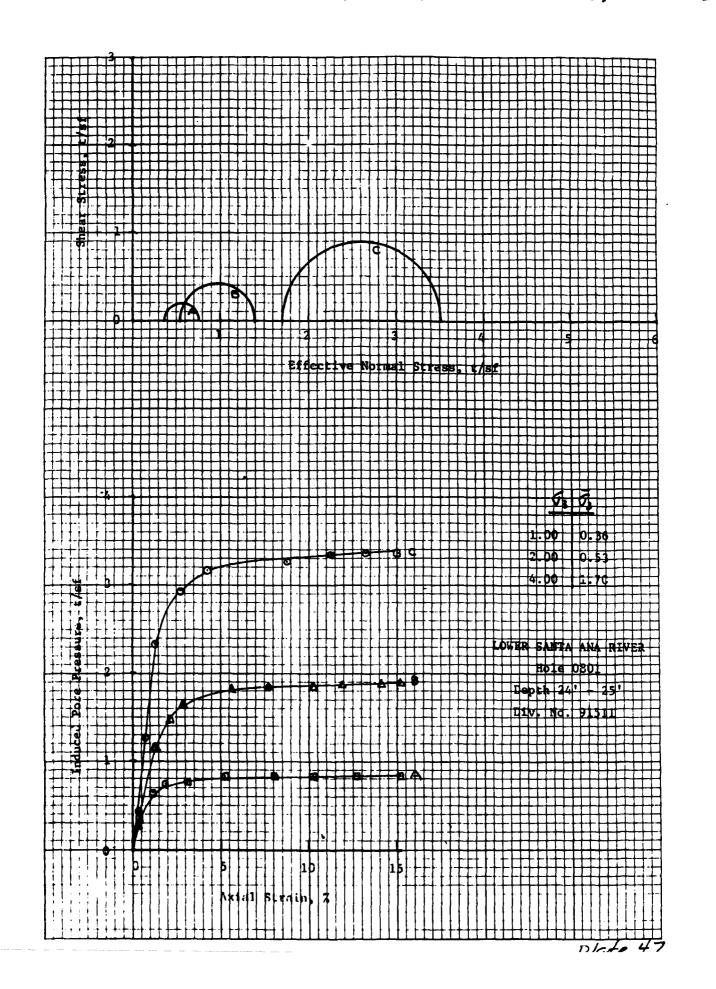
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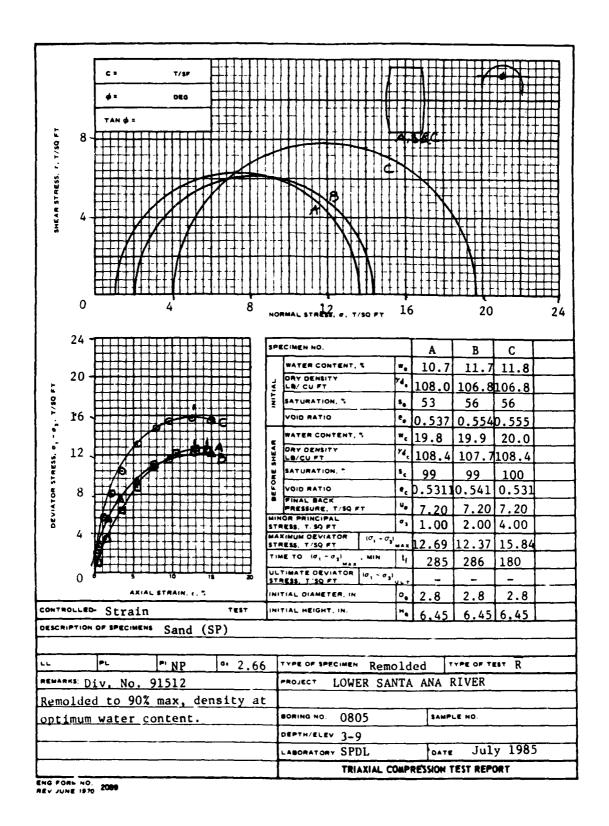


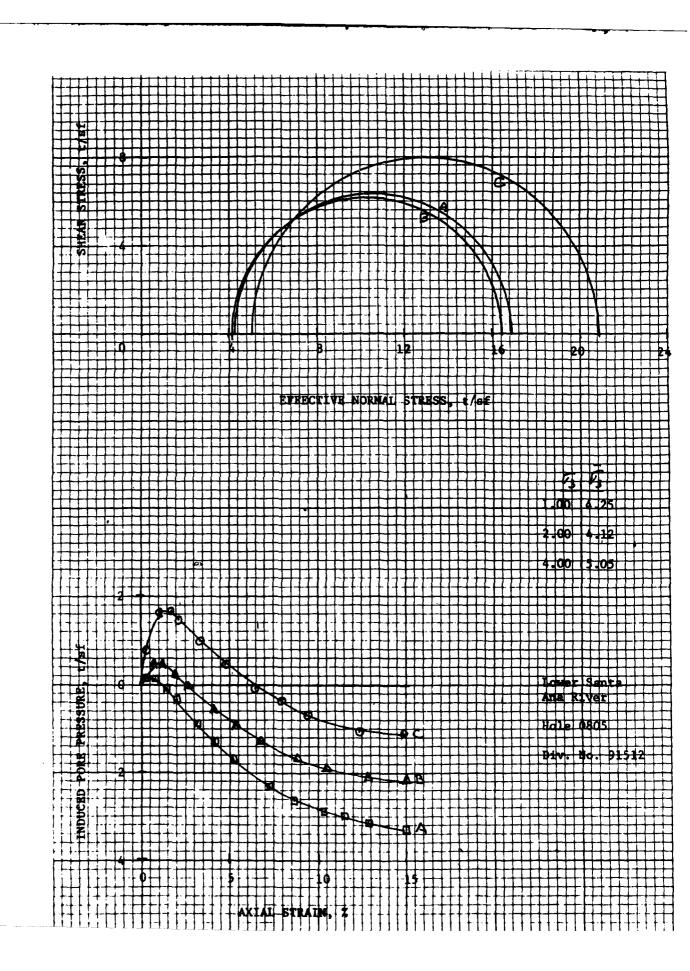


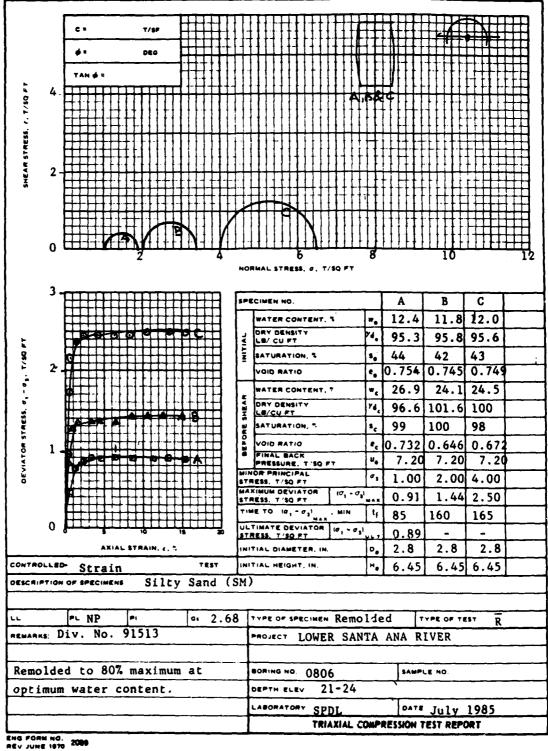


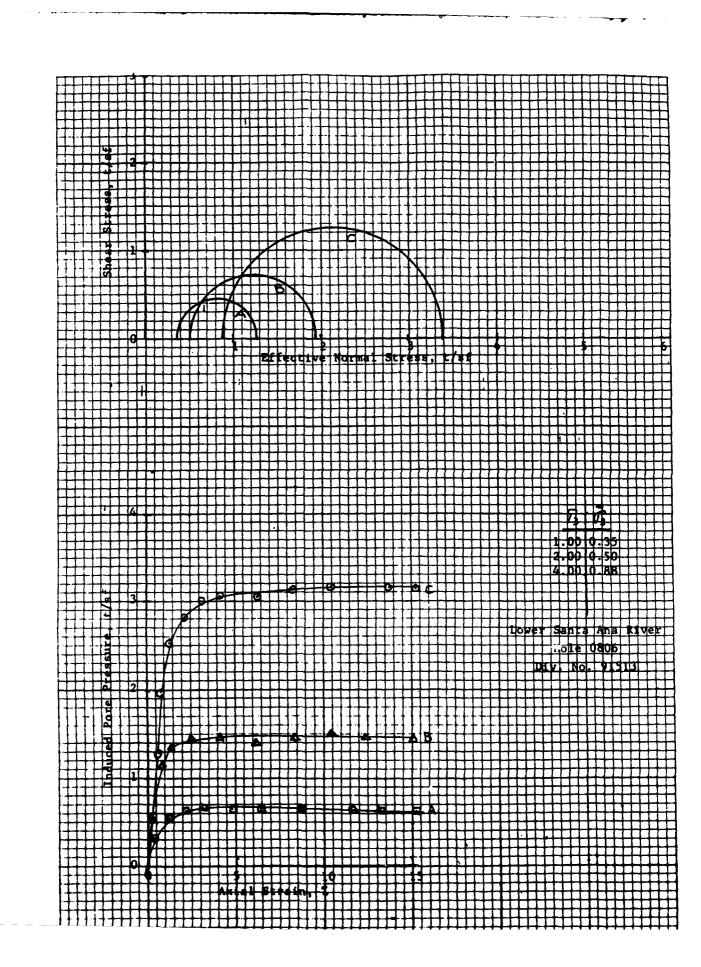
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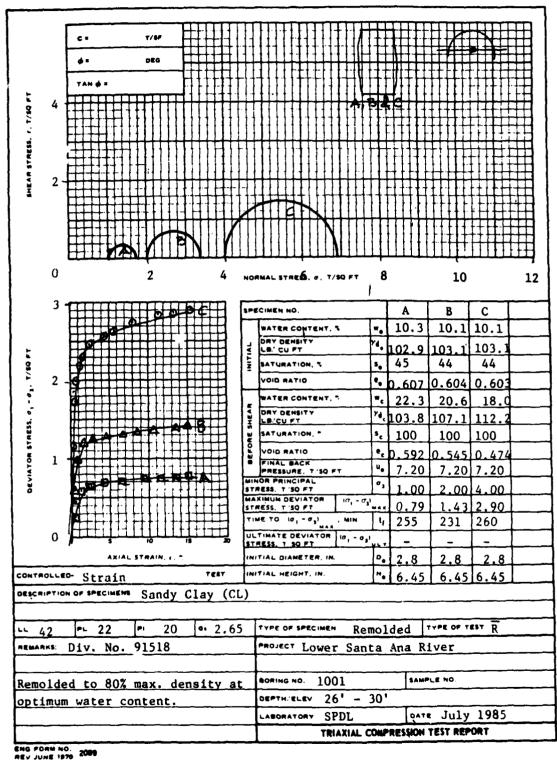


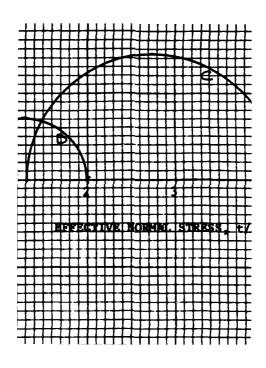


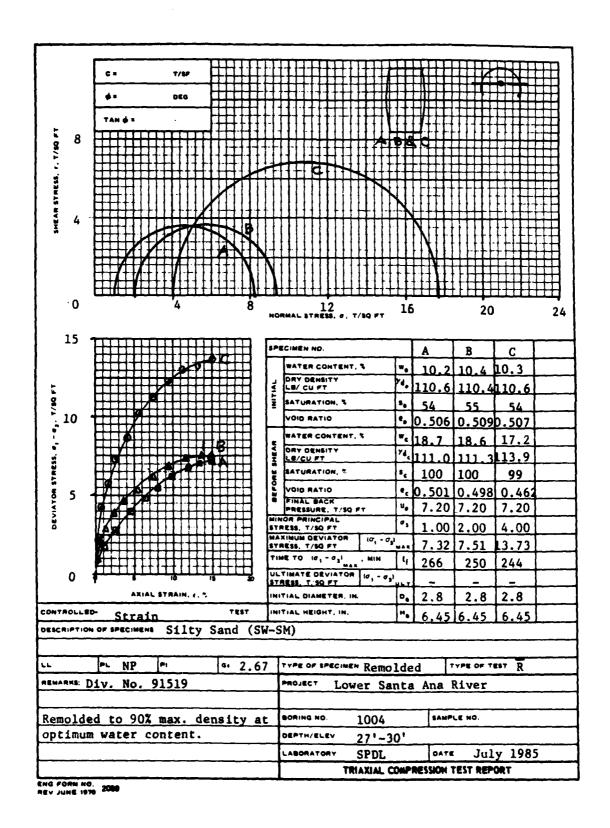


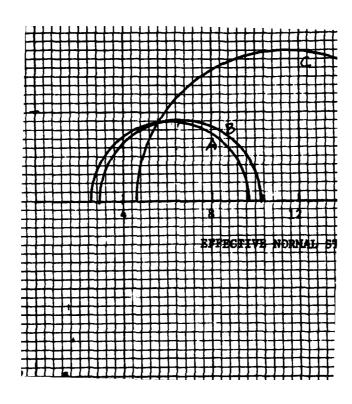


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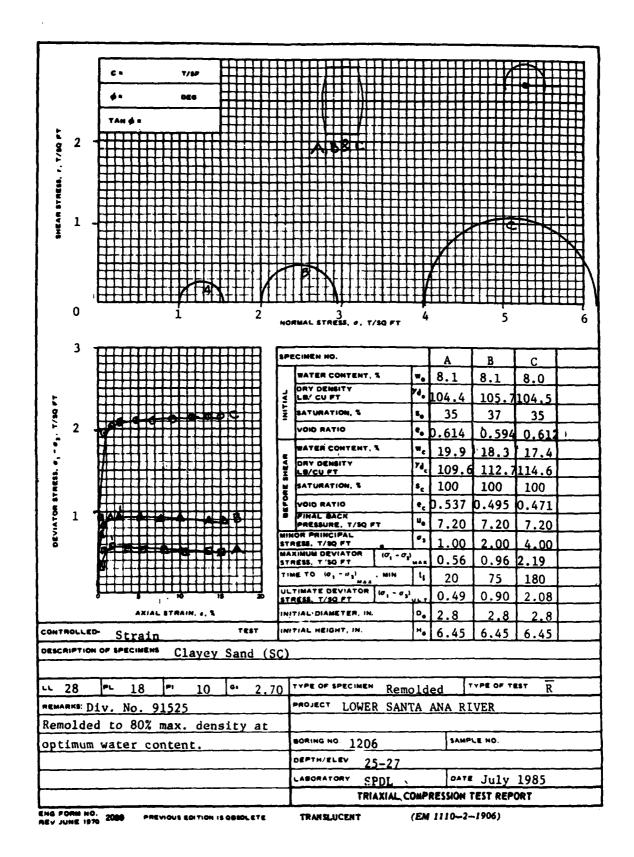
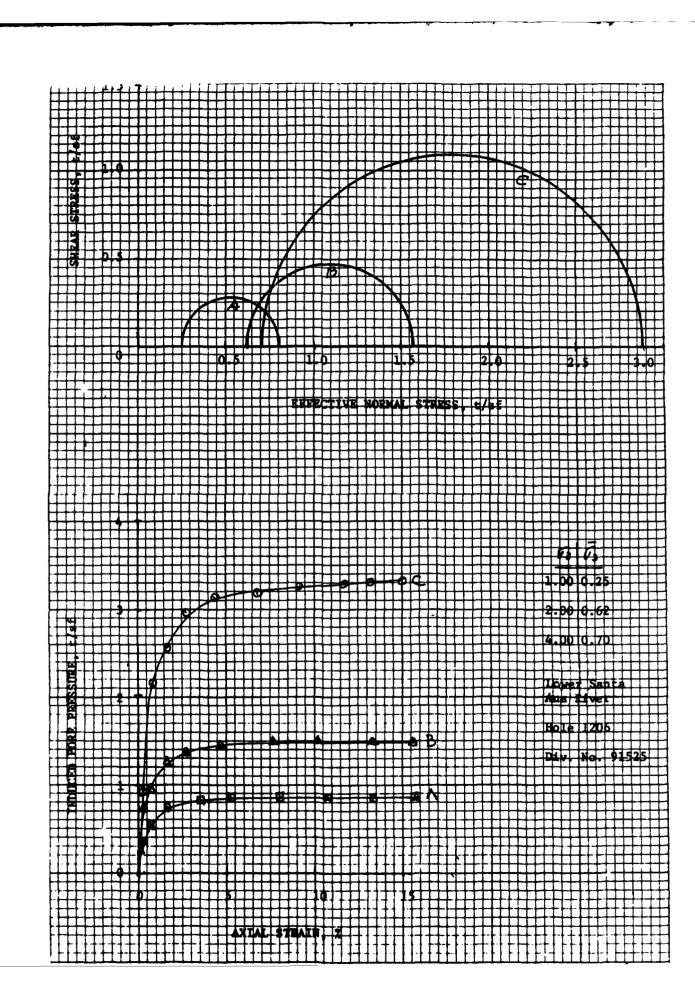
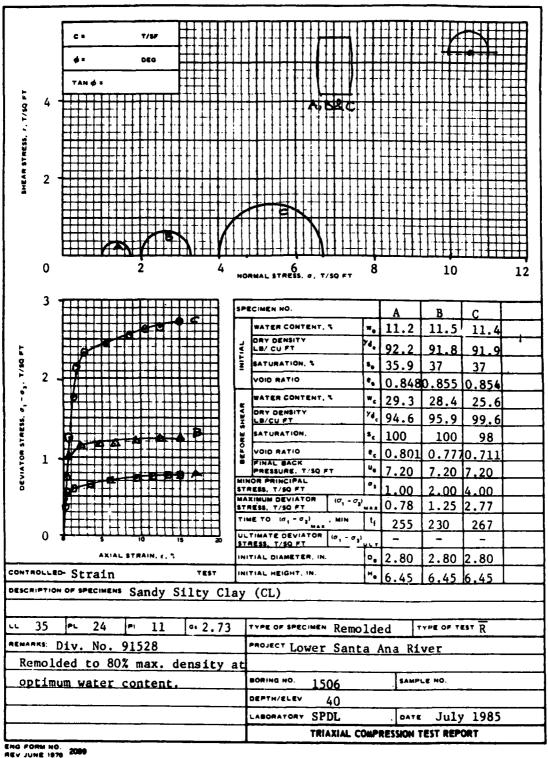
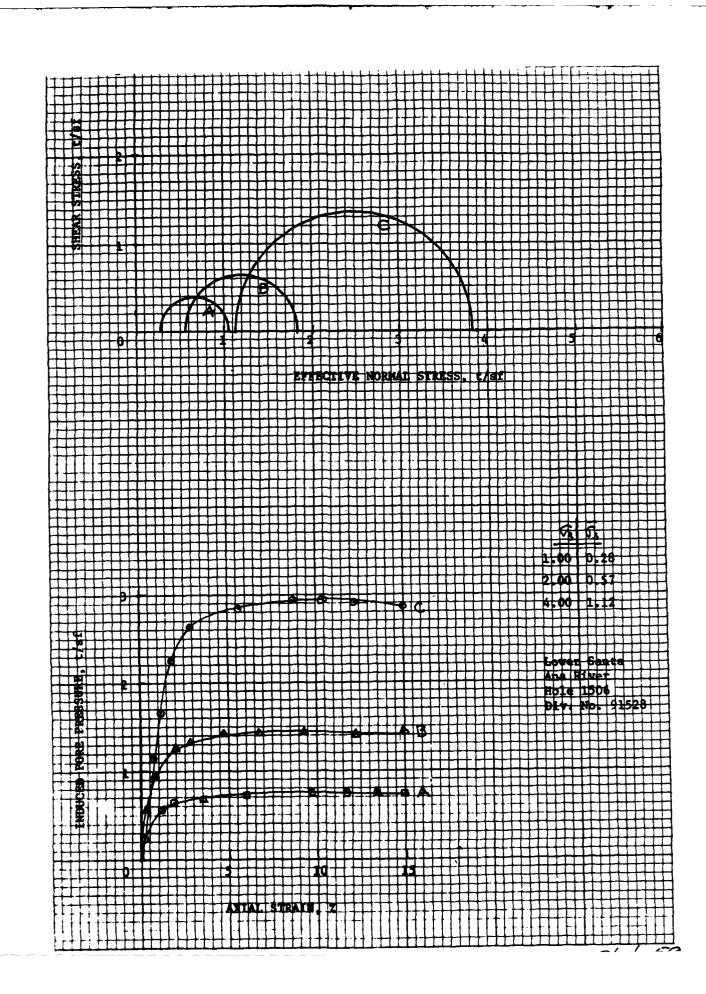
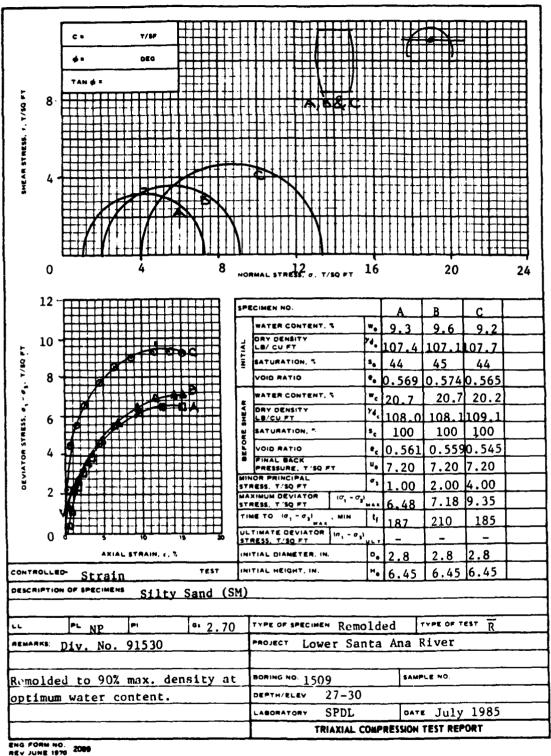


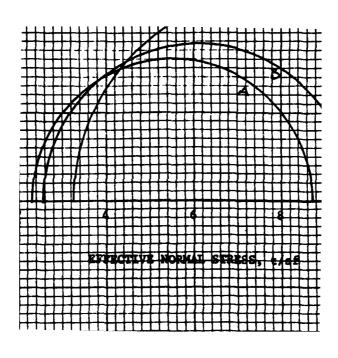
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DEPARTMENT OF THE ARMY SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS LABORATORY



REPORT OF SOIL TESTS

LOWER SANTA ANA RIVER

EDITED

January 1986

SAUSALITO, CALIFORNIA

REPORT OF SOIL TESTS

LOWER SANTA ANA RIVER

January 1986

AUTHORIZATION

1. Results of tests reported herein were requested by the Los Angeles District in laboratory request No. E86-86-0033 dated 10 December 1985.

REFERENCE

2. "Report of Soil Test, Lower Santa Ana River", December 1985, South Pacific Division Laboratory, Sausalito, California.

SAMPLES

3. Disturbed samples contained in sacks were received 25 March 1985. Identification of samples is shown on the Soil Test Result Summary, Plate 1, and in referenced report.

TESTING PROGRAM

4. The program was in general accordance with the test request and included compacation and permeability.

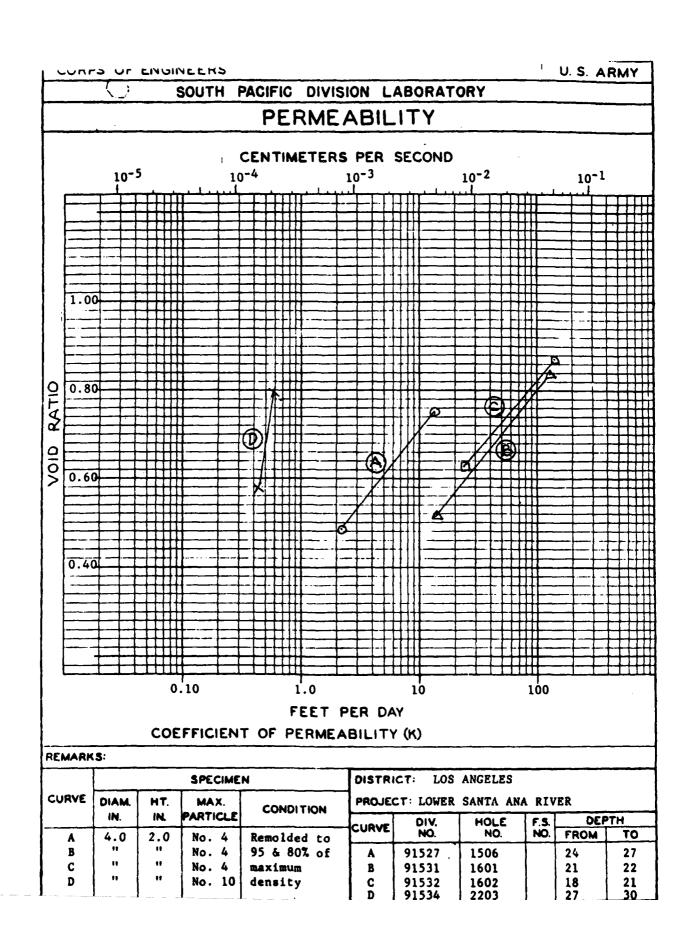
TEST METHODS

5. Permeability and Compaction. Testing conformed to the procedures described in Engineer Manual, EM 1110-2-1906, "Laboratory Soil Testing," 30 November 1970.

TSULTS

6. Results of tests are shown on the following plates:

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Soil Test Result Summary	1
Compaction Test Report	2
Permeability	3



B COASTAL DESIGN

APPENDIX B COASTAL DESIGN

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I. GENERAL

Purpose and Scope

1-01 This section presents the results of investigations made for the Lower Santa Ana River in connection with the flood control channel improvement as the River empties into the Pacific Ocean. The objective of this appendix is to provide the structural design of the Santa Ana River Channel Jetties, the training dike, and to determine the impact of shoreline changes as a result of the Santa Ana River Flood Control Project.

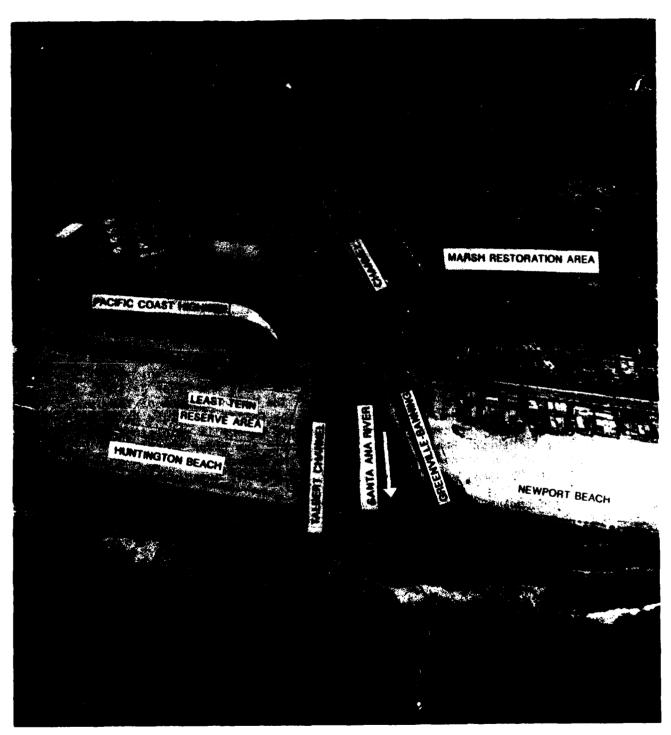


PHOTO 1: LOOKING UPSTREAM FROM MOUTH, LEAST TERM NESTING COLONY TO THE LEFT OF TALBERT CHANNEL.

II. EXISTING CONDITION

Location

2-01 Flows from the Santa Ana River empty into the Pacific Ocean between the cities of Huntington Beach and Newport Beach. The two cities occupy the plateau area which rises about 40 feet above the shoreline. Adjacent to the river on the northeast side of the Pacific Coast Highway is a degraded marsh area used for oil production. The shoreline is a continuous beach broken by the Santa Ana River jetties, and the beach is about 700-800 feet wide. The beach upcoast of the river (Huntington Beach) is maintained by the California State Parks and Recreation while the beach downcoast (Newport Beach) is maintained by the City of Newport Beach. The existing Santa Ana River mouth is composed of four stone jetties separating the Talbert, Greenville-Banning, and the Santa Ana River channel ocean outlets.

2-02 The center and main channel is the Santa Ana River flood-control outlet. The downcoast outlet is the Greenville-Banning and the upcoast outlet is the Talbert Channel. See photo 1, page B-I-2.

Santa Ana River Jetties

2-03 The Santa Ana River jetties consist of two rubble mound structures from Pacific Coast Highway (PCH) to the ocean, terminating near the low water line on Huntington Beach, a distance of about 900 feet. The two jetties form the main channel of the Santa Ana River. The east jetty (downcoast) is about 850 feet long. The west jetty (upcoast) is about 480 feet long and connects with a vertical concrete wall about 420 feet long to PCH. The crest elevations of the two jetties are about +10 feet mean sea level (MSL). The river side slopes of the jetties is 1V on 2H and 1V to 1.75H on the back side.

Shoaling of Santa Ana River

2-04 The Santa Ana River jetties were constructed in 1958, to convey floods from the Santa Ana River to the ocean. The width of the river varies from about 170 feet at PCH to about 320 feet at the ocean. The invert of the river was excavated to a -4.76 feet MSL or -1.96 feet mean lower low water (MLLW) by Orange County Flood Control District during the construction of the two jetties in 1958. Since 1958, the river mouth has shoaled with littoral material to an estimated elevation of +5.0 feet MSL or +7.8 feet MLLW. The Flood Control District often times has to remove portions of the littoral material during the summer months in the riverbed to provide a low flow channel for tidal exchange in the river.

2-05 A river mouth closure study was made by Tekmarine, Incorporated, Sierra Madre, California, for the Los Angeles District in 1986. Fifteen aerial photographs taken between June 1974 and July 1985 were analyzed. Six of the photos were taken during the summer (May-Oct) and nine were taken during the winter months (Nov-Apr). The analysis indicated that the Santa Ana River was open on 11 occasions (73 percent). The analysis also indicated that when the Santa Ana River mouth was closed, the sand plug appeared to have been created by littoral material moving to the northwest (upcoast direction).

Talbert Channel Jetty

2-06 The Talbert Channel jetty is a rubble mound structure about 200 feet long that begins near the low water line on the State Beach extending landward to join with the stone revetment of the Talbert Channel. The crest elevation of the jetty is about +10 feet MSL. The slopes of the jetty is 1V to 2H on the channel face and 1V to 1.5H on the back side.

Shoaling of Talbert Channel

2-07 The rubble mound jetty and stone revetment on the upcoast end of the Talbert Channel and the Santa Ana River west jetty form the ocean outlet for the Talbert Channel. The outlet is about 880 feet long from PCH to the ocean. Talbert Channel is a trapezoidal earth channel that was constructed by Orange County Flood Control District in the 1960's to collect and convey local storm runoff in the cities of Fountain Valley and Huntington Beach to the ocean, a distance of about 5.7 miles. The outlet channel is about 70 feet wide. The Talbert Channel outlet is opened to the ocean about 93 percent of the time for tidal exchange. On the occasions when the outlet was closed, the sand plug appeared to have been created by littoral material moving to the southeast (downcoast direction).

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plate 60

III. TIDES

3-01 The tides along the Pacific Coast have a semidiurnal inequality. Tidal data for the Santa Ana River and vicinity are given in the following table 1:

Table 1. Tidal Data.

Location	Mean Range Feet	Diurnal Range Feet
Balboa (ocean pier)	3.6	5.3
Santa Ana River Entrance (inside)	2.4	3.3
Los Patos (Warner Avenue Bridge)	3.4	4.7
Long Beach, Outlet Harbor Pier A	3.7	5.3

3-02 The mean tidal range is the difference in height between mean high water and mean low water. The diurnal range is the difference in height between mean higher high water and mean lower low water. The maximum annual tide range is from minus 1.9 feet to plus 7.3 feet (MLLW).

3-03 At the Newport Bay Entrance is the closest tide station for which long-term records have been obtained (July 1955 to the present). The most recent tidal elevation data available for the Newport Bay Entrance station are summarized in the following table 2. All elevations are based upon the 1960-1978 tidal epoch with the exception of Extreme High and Extreme Low Water, which represent the historical maximum and minimum water levels recorded at the station.

3-04 The Mean Sea Level Datum (0.0 MSL) is equal to +2.8 feet Mean Lower Low Datum (+2.8 MLLW) for the Newport Bay Entrance.

Table 2. Tidal Elevations at Newport Bay Entrance.

Extreme High Water.	7.86 ft mllw
Mean Higher High Water	5.40 ft mllw
Mean High Water	4.65 ft mllw
Mean Tide Level	2.79 ft mllw
Mean Sea Level	2.76 ft mllw
Mean Low Water	0.93 ft mllw
Mean Lower Low Water	00.0 ft mllw

Note: Station located at 33°36'N; 117°53'W.

IV. CLIMATE

Temperature and Precipitation

4-01 Average daily minimum/maximum temperatures (degrees Fahrenheit) range from 46/63 in winter to 63/74 in summer. All-time low/high extremes of temperature are about 27/110. The area does not experience significant periods of freezing temperatures. Normal annual precipitation over the Lower Santa Ana River ranges from about 10 to 12 inches.

General Winter Storms

4-02 Most precipitation over southern California coastal drainages occurs during the cool season, primarily from November through early April, as mid-latitude cyclones from the north Pacific Ocean occasionally move across the West Coast of the United States to bring precipitation to southern California. Most of these storms are of the general winter type, with hours of light to moderate steady precipitation, but with occasionally heavy showers or thunderstorms embedded. Although these storms frequently produce significant snow in the upper Santa Ana River basin and other high-altitude drainages above 6,000 feet, snowfall and snowmelt are almost non-existent in the Lower Santa Ana River basin.

Local Thunderstorms

4-03 Local thunderstorms can occur in southern California at any time of the year, but are least common and least intense during the late spring. These types of storms occur fairly frequently in the coastal areas during or just after general winter storms. They can also occur between early July and early October, when desert thunderstorms occasionally drift westward across the mountains into coastal areas, sometimes enhanced by moisture drifting northward from tropical storms off the west coast of Mexico. Local thunderstorms can also occur throughout the fall, as upper-level low-pressure centers sometimes trigger left-over summer moisture. These local thunderstorms can at

times result in very heavy rain for short periods of time over small areas, causing very rapid runoff from small drainages. Intense thunderstorms can also be accompanied by hail and strong, very erratic winds. On a rare occasion, a severe thunderstorm can spawn a small tornado or waterspout in southern California.

General Summer Storms

4-04 General summer storms in southern California are quite rare, but on occasion a tropical storm from off the west coast of Mexico can drift far enough northward to bring rain, occasionally heavy, to southern California, sometimes with very heavy thunderstorms embedded. The season in which these storms are the most likely to significantly affect southern California is mid-August through early October, although there have been some effects in southern California from tropical storms as early as late June and as late as early November.

4-05 On rare occasions, southern California has received light rain from non-tropical general summer storms, some of which have exhibited some characteristics of general winter storms.

Wind

4-06 The prevailing wind in northern Orange County is the sea breeze. This gentle onshore wind is normally strongest during late spring and summer afternoons, with speeds over the Lower Santa Ana River basin normally 10 to 15 miles per hour. The prevailing wind near the mouth of the Santa Ana River between April and November is west to west-southwest about 7-9 mph. The Santa Ana is a dry desert wind that blows from out of the northeast, most frequently during late fall and winter. Santa Ana winds over the Lower Santa Ana River basin typically average 15 to 20 mph, with gusts to 30-35 mph. On frequent occasions, however, these winds can reach 40 to 45 mph with extreme gusts to 65 mph or greater. These winds are sometimes accompanied by considerable blowing dust and sand.

4-07 Rainstorm-related winds are the next most common type in southern California. Winds from the southwest ahead of an approaching storm average 20-25 mph, with occasional gusts to more than 40 mph. West to northwest winds behind storms often exceed 25 mph, with gusts to 35 mph, but on occasion can rival the Santa Ana winds for speed and gustiness.

Evaporation

4-08 Few formal studies of evaporation have been made in Orange County. Studies from nearby locations indicate that mean daily evaporation ranges from about one-quarter inch in winter to about one-half inch in summer. On days of very strong, dry Santa Ana winds, evaporation can be considerably greater than one inch.

4-09 Dense Fog is fairly common along the southern California coast, especially during the late fall and winter months. On occasion, visibility along the coast between Newport Beach and Seal Beach can decrease to less than 100 feet during the night and early morning hours. Foggy days average about 1 to 2 per month during November, December, and January. During the late spring and early summer, a low cloud deck, some known as "high fog" is prevalent in coastal southern California during night and morning hours, but visibility is seldom reduced to less than 1 mile.

V. WAVE CLIMATE

Wave Exposure Windows

5-01 The section of coastline where the Santa Ana River discharges into the Pacific Ocean is protected to a significant degree from open ocean wave attack by the sheltering effects afforded by the offshore islands of San Clemente, Santa Catalina, San Nicolas, San Miguel, Santa Rosa, Santa Cruz, and, to a lesser extent, Anacapa and Santa Barbara. The shielding provided by the coastline orientation also limits direct wave approach from the northwest direction, since Point Fermin effectively precludes northern hemisphere swell or sea from propagating down the Santa Barbara Channel and into San Pedro Bay (see fig. 1).

5-02 Northern hemisphere swell generated by storms on the North Pacific Ocean can approach the Santa Ana River mouth study region from basically two wave exposure windows. The first window permits northern hemisphere swell propagating from essentially a westward direction to pass through the Santa Cruz Basin between San Nicolas and Santa Cruz Islands, cross the San Pedro Channel, and approach the coastline of interest. This exposure window extends from about azimuth 265 deg to about azimuth 277 deg. A second wave exposure window permits northern hemisphere swell generated by storms on the North Pacific Ocean, and southern hemisphere swell generated by storms on the South Pacific Ocean, to reach the Santa Ana River mouth region from southerly directions. Such swell passes between the mainland coast of southern California and San Clemente and Santa Catalina Islands, traverses the Gulf of Santa Catalina, and impacts the study area. This exposure window extends from the coastline in a southerly direction with an aziumuth of approximately 155 deg to an azimuth directed from the study region toward San Clemente Island, an azimuth of approximately 200 deg. Sea waves can approach the study region from all directions of possible generation from about azimuth 155 deg to about azimuth 277 deg.

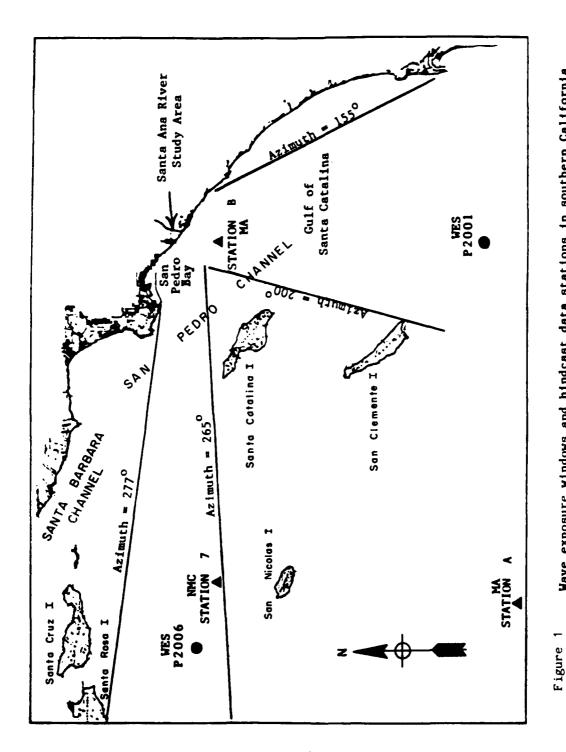


Figure 1 Wave exposure windows and hindcast data stations in southern California coastal waters for Marine Advisers (MA), National Marine Consultants (NMC), and U. S. Army Engineer Waterways Experiment Station (WIS).

Wave Data Sources

MARINE ADVISERS (1961)

5-03 Wave hindcasts have been prepared by Marine Advisers (1961) for three specific locations in deep water off the southern California coastline, one of which (Station A) is located in the open ocean beyond the sheltering islands. Station A is located approximately 65 nautical miles southwest of San Clemente Island, and is exposed to open water influences from southeast through west to north-northwest. Station A is considered to be representative of conditions outside the offshore islands. Wave hindcast frequency of occurrence data have been developed at Station A for sea, northern hemisphere swell, and southern hemisphere swell, for 3 years of record (1956-1958). Marine Advisers (1961) Station B is located approximately 8 nautical miles off Newport Beach in sheltered deep water. Decayed sea data from Station A were transferred past the sheltering islands and combined with locally generated sea to produce a sea wave climate at Station B which consisted of decayed plus local sea arriving from southeast through northwest directions. These decayed and local sea hindcast wave data of Station B are an indication of relatively short period waves which exist in the Gulf of Santa Catalina and San Pedro Channel, and which may approach the shore of southern California near the Santa Ana River mouth region. Station B also contains information regarding sheltered northern hemisphere swell and southern hemisphere swell which was transferred past the offshore islands by numerical techniques capable of deducing the reduction in wave height and sheltered direction of approach after passing the islands.

WATIONAL MARINE CONSULTANTS (1960)

5-04 National Marine Consultants (1960) also developed hindcast wave statistics for sea and northern hemisphere swell at Station 7 in deep water off the coast of southern California, for the same 3 years of record (1956-1958). Station 7 is located in the Santa Cruz Basin between San Nicolas Island and Santa Cruz Island, due west of San Pedro Bay. During the development of the hindcast wave statistics at Station 7, consideration was given to the effects of San Nicolas Island to the south, and to Santa Cruz and Santa Rosa Islands to the north. Hence, the resulting hindcast sea and northern hemisphere swell statistics deduced for Station 7 which arrive from a westerly direction propagate directly across the San Pedro Channel and approach the coastline of southern California in the vicinity of the Santa Ana River mouth region.

WAVE INFORMATION STUDY

5-05 A new generation of hindcast wave data are being developed for the Pacific Coast of the United States by the Wave Information Study (WIS) of the U.S. Army Engineer Waterways Experiment Station (WES), for a much greater time period than the 3 years of record used by Marine Advisers (1961) and National Marine Consultants (1960). WIS has computed the

wave climatology of sea and northern hemisphere swell for the U.S. Pacific Coast for three different phases, utilizing 20 years of record (1956-1975) computed at 3-hour intervals. Phase I data have been computed with a grid spacing of 120 nautical miles, and have established 35 stations located near the Pacific coastline. Phase II data have been computed for 53 stations closer to the shore than the Phase I stations. The Phase II grid spacing was established at 30 nautical miles, to provide a better representation of the effects of the geometry of the coastline (but not the effects of the offshore islands) on wave generation near the Pacific coast. Phase III nearshore wave transformation data have been computed for 134 stations from the Canadian border to Point Conception, with each coastal segment being approximately 10 nautical miles in length. The nearshore wave transformation procedures applied to the coastal region between the Canadian border and Point Conception are not applicable to the sheltered Southern California Bight region adjacent to the Santa Ana River mouth region of southern California. Actual nearshore wave hindcasting is presently being performed for the Bight with a much finer grid (10 nautical miles and 5 nautical miles) than that previously used in Phase II hindcasting. Efforts are presently underway to make the nearshore wave hindcast data available for the Southern California Bight, and thus for the San Pedro Channel, San Pedro Bay, and the Gulf of Santa Catalina. Southern Hemisphere swell are also being developed as part of this effort. Upon completion, this WIS study will provide the most complete and detailed wave climate of any coastal region of the nation for the Southern California Bight. Several wave roses are shown in figures 2 through 5.

Wave Conditions

5-06 Wind-generated surface gravity waves produce the most powerful wave forces to which coastal structures are subjected (except for seismic waves). In the absence of a wave gaging program at the project site, the wave characteristics are usually determined by hindcast methods in deep water and then analytically propagated shoreward to the structure. This method has been applied for the Santa Ana River, where the deep water unsheltered wave hindcast data of Marine Advisers (1961) Station A for southern hemisphere swell, and National Marine Consultants (1960) Station 7 for northern hemisphere swell, and Marine Advisers (1961) Station B decayed and local sea have been utilized. Adjustments for island sheltering effects were also included. The deep water waves were then refracted and shoaled by numerical wave propagation methods, resulting in a frequency of occurrence of waves of various heights, periods, and directions of approach at the project area. This analysis is detailed by U.S. Army Engineer Waterways Experiment Station (WES) Technical Report HL-80-9, 1980. Western and southern wave exposures of the Santa Ana River study area are shown in figure 1.

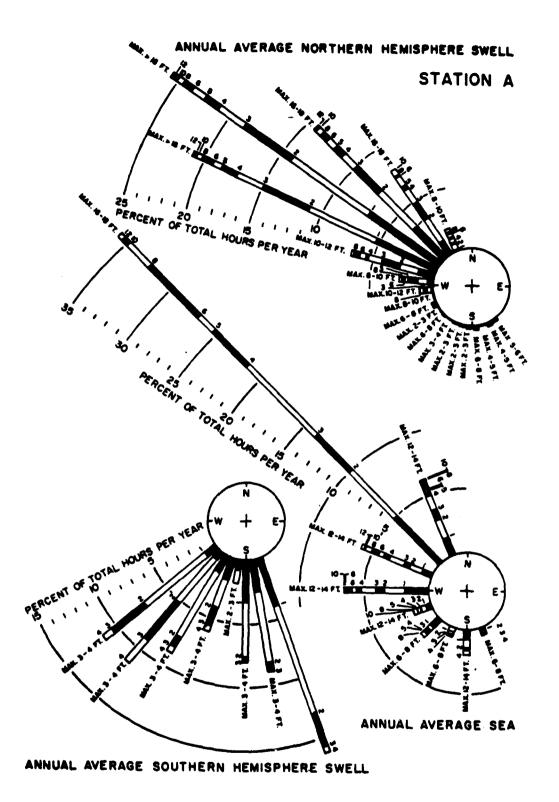


Figure 2 Average annual hindcast wave statistics, southern California coastal waters, Station A, sea, northern hemisphere swell, and southern hemisphere swell (after Marine Advisers, 1961).

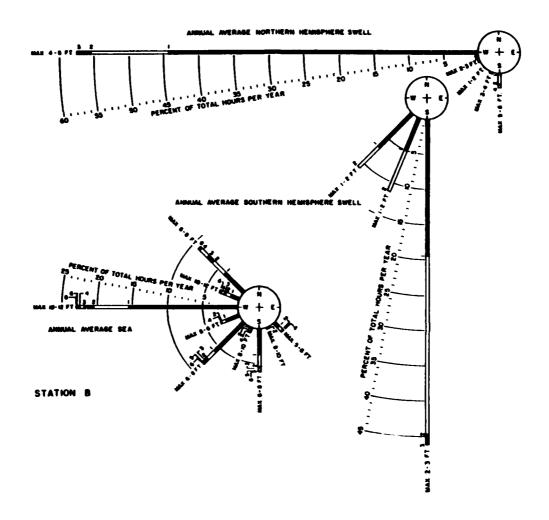


Figure 3 Average annual hindcast wave statistics, southern California coastal waters, Station B, sea, northern hemisphere swell, and southern hemisphere swell (after Marine Advisers, 1961).

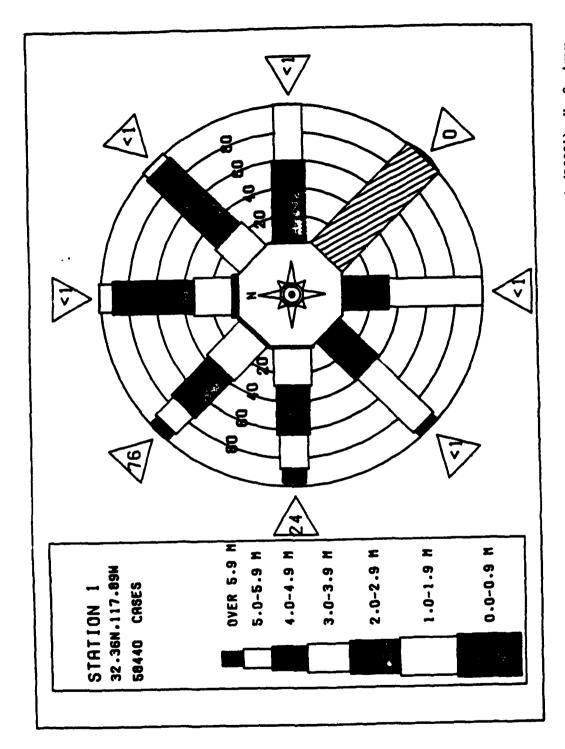


Figure 14 . Combined sea and northern hemisphere swell, Phase II, Station 1 (P2001), U. S. Army Engineer Waterways Experiment Station (WES) Wave Information Study (WIS) (after Corson, et al., 1987).

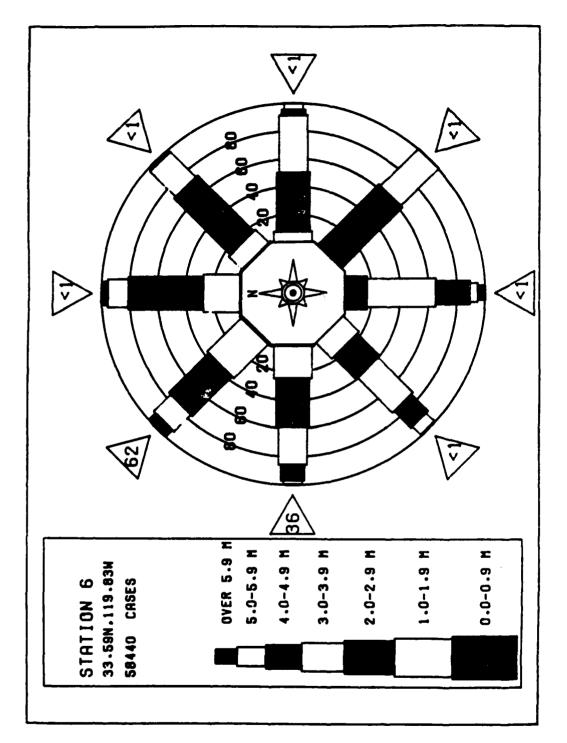


Figure 5 . Combined sea and northern hemisphere swell, Phase II, Station 6 (P2006), U. S. Army Engineer Waterways Experiment Station (WES) Wave Information Study (WIS) (after Corson, et al., 1987). Figure 5

)

5-07 It was determined by Hales (1980) that the Santa Ana River mouth region is exposed to southern hemisphere swell arriving from azimuths 155 degrees to 200 degrees, with unrefracted sheltered deepwater significant wave heights ranging up to 4 feet. These heights, even with periods up to 20 seconds, are not adequate to inflict significant structural damage. Northern hemisphere swell arrives from azimuths 265 degrees to 277 degrees, with unrefracted sheltered deepwater significant wave heights ranging from 13 feet to 15 feet, and associated periods of 10 seconds to 14 seconds. These waves are capable of causing extensive structural damages; however, water depth-limiting conditions on wave heights reduce these extreme wave heights through the breaking process, and such excessive wave heights never break directly on the rubble structure. Shorter-period, locally generated waves with correspondingly large heights exist periodically in deep water off the Santa Ana River mouth region, but the depth-limited breaking process prevents these local sea from striking the structures with extremely high waves. The actual damage caused by the depth-limited breaking wave is inflicted by northern hemisphere swell instead of locally generated sea. Breaking wave damage increases with wave period, other factors remaining constant.

Wave Frequency

5-08 Damage to rubble mound structures is usually progressive, and an extended period of destructive wave action is required before a structure ceases to provide protection. It is, therefore, necessary in selecting a design wave to consider both frequency of occurrence of damaging waves and economics of construction and rehabilitation. The highest waves with the longest periods which occur with some significant discernible degree of frequency at this location are the 10.0-12.0 second waves (0.05 percent occurrence) and the 12.0-14.0 second waves (0.09 percent occurrence) approaching from a westerly direction (azimuth = 270 degrees) (table 3).

5-09 These data are Station 7 data from National Marine Consultants, (1960). Source: Hales (1980).

Design Stillwater Level

5-10 The actual wave conditions at a structure site at any time depend critically on the water level. Consequently, a design still water level must be established in determining the maximum wave forces on a structure. For the Santa Ana River project, the design still water level (SWL) has been established at +7.0 feet MLLW, or +4.2 feet MSL. The design still water level is based on the 1986 high and low water predictions at the Long Beach (Outer Harbor) station by the National Oceanic and Atmospheric Administration (NOAA). The NOAA predicted that a tide level of 7 feet would be exceeded eight times in 1986, once in January, twice in June and December, and thrice in July. The high water prediction by NOAA for 1986 range from 7.0 to 7.3 feet. The extreme high-water level observed by NOAA was 7.86 feet on January 28, 1983.

Table 3. Frequency of Annual Occurrence in Percent of Year, Northern Hemisphere Swell; Santa Ana River Mouth, California.

Deepwater Approach Azimuth = 259° - 281°

Significant Wave Height,			Wave Pe	eriod, sec	onds		
Feet	6-7.9	8-9.9	10-11.9	12-13.9	14-15.9	16-17.9	18+
1.0-1.9	0.02	0.48	0.23	0.02	0.05		
2.0-2.9	0.88	2.07	1.06	0.62	0.35	0.11	0.02
3.0-3.9	0.42	0.87	0.50	0.35	0.02	0.09	0.02
4.0-4.9	0.16	0.48	0.23	0.09	0.12	0.02	
5.0-5.9	0.12	0.28	0.32	0.14	0.10		
6.0-6.9		0.31	0.32	0.12	0.07	0.05	
7.0-8.9		0.22	0.32	0.20	0.02		
9.0-10.9		0.02	0.23	0.16	0.10		
11.0-12.9			0.17	0.02	0.07	0.02	
13.0-14.9			0.05	0.09			
15.0-16.9							

Design Wave

5-11 The proposed Santa Ana River jetties and training dike will terminate at the river mouth in approximately the same location as the existing stone jetties at a depth of about -4.0 feet MLLW. The head sections of the jetties and training dike will be subjected to the full force of ocean waves generated on the Pacific Ocean and propagating past the offshore sheltering islands toward the coastline. Because of the reduction in height afforded by the islands, the waves which finally reach shore will be limited in height to the maximum wave sustainable in water at that specific depth. The forces created by these depth limited breaking waves will constitute the greatest wave forces which the structure will be expected to withstand. These maximum wave forces may arrive simultaneously with extreme high tide and flood conditions on the river, resulting in a larger resultant total force on the structure elements.

5-12 In determining the design wave for the Santa Ana River jetties and training dike, it is assumed that the flood control channel will be excavated to an invert elevation or -4 feet MLLW at the toe of the end of the jetties, and excavation will be maintained horizontally (m=0) until this elevation intersects the existing beach slope seaward of the structure. Hence, the greatest water depth will occur when the SWL is at +7 feet MLLW immediately after construction of the flood channel to an elevation of -4 feet MLLW (assuming the channel does not degrade below the design invert elevation). This maximum still water depth will be 11 feet. The largest wave height which can be maintained in water 11 feet deep on a horizontal slope is about 9 feet ($H=0.78 \times 11$). Table 3 indicates the 14 second wave occurs with significant regularity.

Thus, the 14 seconds, 9 feet breaking wave is considered to be the design wave for the Santa Ana River jetties and the training dike. Other sections further upstream between the ocean and the Pacific Coast Highway will experience broken or diffracted waves of lesser magnitude.

5-13 The design wave at the ocean end of the Santa Ana River jetties (14 sec. 9 ft. breaking wave) is the extreme worst wave condition to be reasonably expected under conditions of complete channel excavation. When this excavated channel shoals to some extent by longshore transport of littoral material in the surf zone or by river transport from upstream, the breaking wave conditions on the structure will be reduced from the maximum valued produced by the design wave height of 9 feet. The actual wave forces depend on the actual wave height, which in turn depends on the actual water depth at the local site.

5-14 Because of inherent instabilities in the breaking process, and since waves will approach at a range of angles to the shoreline (up to plus or minus 30 degrees), breaking of the design wave (14 sec., 9 ft. breaking wave) may not always occur precisely at the tip of the rubble structure head section. However, breaking of the design wave should occur within about 200 feet of the river entrance. That is, all breaking of the design wave should take place before it propagates upriver past west jetty station 9+60 (east jetty sta. 10+30). Hence, the design wave (14 sec., 9 ft. breaking wave) is utilized for both the rubble structure head section and structure trunk section (west jetty stas. 7+90 to 9+60 and east jetty stas. 8+60 to 10+30).

5-15 The wave height reduction by diffraction upriver from the rubble structure head section was estimated by graphical methods for non-breaking waves as discussed in the Shore Protection Manual (1984). For breaking waves, after breaking, the reformed wave height is estimated to be approximately equal to 40 percent of the local water depth. The broken and reformed wave height will be $0.4 \times 11.0 = 4.4$ feet, say 5 feet, upriver beyond the trunk section (west jetty stas. 9+60 to 11+90 and east jetty stas. 10+30 to 12+60). This value is larger than a non-breaking diffracted wave upriver between the jetties, and is used to design the riprap for the embankment of the jetties. Further up the channel, waves get smaller. Between west jetty stations 11+90 and 13+52 (east jetty stas. 12+60 to 14+22) waves will be about 3 feet high.

VI. LITTORAL TRANSPORT

Condition of Existing Beaches

6-01 The region of southern California coastline encompassed by a study of littoral transport past the Santa Ana River mouth should commence at approximately the eastern end of the Los Angeles-Long Beach Harbor complex (Anaheim Bay east jetty) and extend southeasterly for a distance of approximately 17 miles to the Newport Bay west jetty. This region is so distinctly separated from the adjacent coastlines by Point Fermin on the north and the Newport Submarine Canyon on the south that it can be effectively considered as a littoral cell, referred to as the San Pedro Littoral Cell by Inman (1976) (see fig. 6). A littoral cell is defined as a coastal segment that contains a complete sedimentation cycle including sources, transport paths, and sinks. This region of coastline satisfies these requirements: i.e., the source being the feeder beach located immediately east of Anaheim Bay (Surfside-Sunset Beach) and infrequent transport to the beach by flooding of the Santa Ana River; the transport path being the surf zone energized by breaking waves; and the ultime sink to the south being either the Newport Submarine Canyon or the shoal region off the Newport Beach region.

6-02 The direction of net longshore transport of littoral material in this vicinity is considered to be southerly by most researchers (Emery, 1960; Shepard and Wanless, 1971; Inman, 1976; Hales, 1980). Any material that may be drifting south past Point Fermin will be deposited in the deep water of San Pedro Bay outside the Los Angeles-Long Beach Harbor breakwaters. Correspondingly, any littoral material drifting south past the Newport Beach groin field will either be lost down the Newport Submarine Canyon, or deposited in deep water on the shoal region of the continental shelf located on the west side of the Canyon (Felix and Gorsline, 1971).

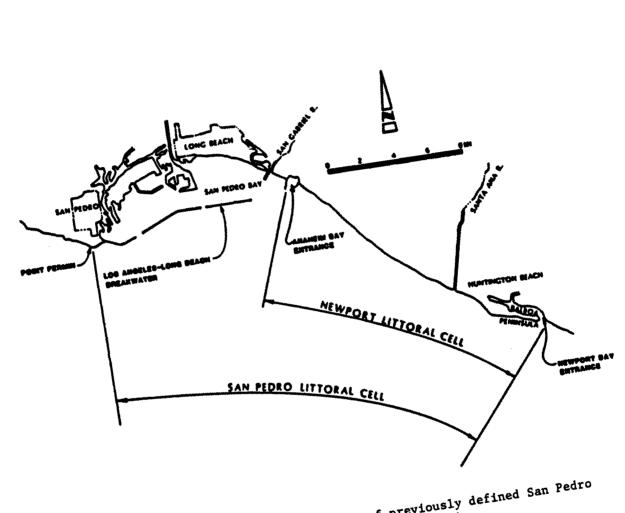


Figure 6 Newport Littoral Cell, a portion of previously defined San Pedro
Littoral Cell (after Everts 1987).

6-03 Since construction of the Anaheim Bay east jetty in 1944, serious erosion of the beaches at Surfside-Sunset Beach has been a continually recurring problem that has necessitated the periodic placement of nourishment material to maintain an acceptable beach for recreation, and for protection of private and public property. The average annual rate of erosion in this area (based on placement volumes and hydrographic surveys) in recent years has been on the order of 300,000 cubic yards per year. Indications are that the net annual littoral drift of material in surf zone is in a southerly direction. Periodic renourishment of the Surfside-Sunset Beach region serves as feeder beach material for Bolsa Chica State Beach, Huntington Beach, and Newport Beach.

6-04 The Santa Ana River enters the Pacific Ocean at the lower extremities of the littoral cell, and has historically contributed a significant amount of sediment to the surf zone. However, in recent years, periods of prolonged drought and the construction of floodwater retarding structures on the river have drastically reduced the amount of river-transported sediment to the ocean. Reduction in the supply of sand to the beaches carries the potential for serious beach erosion. This potential for erosion has been alleviated by extensive beach nourishment at Surfside-Sunset Beach.

6-05 The Santa Ana River mouth region lies immediately upcoast of the Newport Beach groin field. Here, the beaches are relatively wide and stable. The existence of the wide beach upcoast of the Santa Ana River mouth toward Huntington Beach is attributed by Simons, Li, and Associates, Inc. (1987) to the stabilizing control afforded by the location of the west jetty to Talbert Channel, and to the volume of net downcoast movement of littoral material in the surf zone. Immediately after the construction of the west jetty to Talbert Channel, the fillet accumulation against the jetty gradually extended upcoast asymptotically until the existing Huntington Beach shoreline reached a position of dynamic equilibrium. In general, the beach is approximately ±600 feet wide on the upcoast side of the Santa Ana River mouth, and remains at this width because the downcoast end of this segment is fixed at the west jetty to Talbert Channel, and because the adequate nourishment placed on Surfside-Sunset Beach sufficiently reestablishes the asymptotic dynamic location of Huntington Beach following each winter and summer beach cyclic movement offshore and onshore, respectively.

6-06 Further south, the beach near Newport Beach has been stabilized with a groin field, and is approximately ±400 feet wide in this region. The groin field is located immediately north of the Newport Submarine Canyon. This prevents the apparent southerly net movement of littoral drift from depleting the beaches, as it moves either down the Newport Submarine Canyon or onto the shoal adjacent to the Canyon located offshore of the groin field. In either event, this net southerly transport of littoral material is removed from the littoral system, and the reversal in transport direction to the north during summer months would deplete the southern portion of the San Pedro littoral cell were it not for the existence of the Newport Beach groin field.

Littoral Transport Estimate

6-07 Potential longshore sediment transport is defined as the amount of littoral material that a specific wave climate will transport past a region in the presence of an unlimited source (supply) of material. When the feeder beach at Surfside-Sunset Beach has been nourished, an essentially unlimited supply of material exists for transport downcoast past the Santa Ana River mouth region, and on towards the Newport Submarine Canyon and eventually out of the system. Because of the necessity for maintaining a protective beach in the Surfside-Sunset Beach region, ensuing stable beaches result downcoast, and the actual longshore sediment transport past the Santa Ana River mouth region approximates the potential longshore sediment transport of the area.

6-08 Hales (1980) estimated the net longshore transport of littoral material in the surf zone to be toward the southeast with a magnitude of approximately 112,000 cubic yards per year (see table 4). The results of that study compare favorably with historical beach nourishment data for the Surfside-Sunset Beach area (Simons, Li, and Associates, Inc., 1987). This agreement suggests that these littoral estimates provide a reasonable approximation of the actual longshore transport rates. These littoral estimates compare favorably with estimates developed from more recent wave hindcast data by WIS (Phase II), although the definition of sea and swell may not be entirely consistent between the older wave hindcast data of Marine Advisers (1961) and National Marine Consultants (1960), and the more recent WIS data by WES.

Consequence of Littoral Transport Disruption

6-09 For a computational reach of southern California shoreline centered on the Santa Ana River mouth, the net longshore transport of littoral material in the surf zone is toward the southeast, with a magnitude of about 112,000 cubic yards per year on an average annual basis. In consequence, any major disruption of the dynamic equilibrium which presently exists in this region (such as the construction of a long jetty across the surf zone) is likely to cause erosion in the Newport Beach area unless beach nourishment material is placed on the beach south of the Santa Ana River mouth, and in the Newport Beach groin field for that period of time when the Huntington Beach shoreline is responding asymptotically to any lengthened jetty structure across the surf zone. Both the magnitude and direction of longshore transport exhibit distinct seasonal variations, with strong transport toward the southeast dominating in the winter months (January through April), and moderate transport toward the northwest occurring in the summer months (July through October). This annual cycle implies that littoral material would possibly have the capacity for temporary closure of the entrance to the Santa Ana River.

Table 4. Summary of Potential Longshore Transport Computations Santa Ana River Mouth Region, California. (All values in cubic yards)

	Sea	ja ja	Norther	n Swell	Southern Swell	Swell	Sum		Net		
MON 4	Month	GA11th	+ 40 %	4 + 10 0	+ 40 %	4 1 70	- W	140	+ 10 10 10 10 10 10 10 10 10 10 10 10 10	1	
11011011	NOFELL	Soucii	NOFUL	Souch	North	200 00	Norch	South	North	South	Gross
Jan	11,682	28,159	0	68,230	0	0	11,682	96,389		84.707	108,071
Feb	66,681	24,159	0	151,881	0	0	66,681	176,040		109,359	242,721
Mar	24,463	38,253	0	47,827	0	0	24,463	86,350		61,887	110,813
Apr	3,445	29,085	0	48,424	0	0	3,445	77,509		74,064	80,954
May	1,557	22,567	0	10,517	39,604	0	41,161	33,084	8,077	•	74,245
Jun	1,720	16,882	0	2,938	19,429	0	21,149	19,820	1,329		40,969
Ju1	3,681	17,752	5,237	0	84,507	0	93,425	17,752	75,673		111,177
Aug	2,083	16,182	6,498	0	68,904	0	77,485	16,182	61,303		93,667
Sep	958	16,625	15,438	570	53,077	0	69,473	17,195	52,278		86,668
0et	3,810	11,181	3,421	14,168	56,780	0	64,011	25,349	38,662		89,360
Nov	902	14,446	0	2,070	0	0	905	16,516	•	15,614	17,418
Dec	23,220	12,848	0	14,010	0	0	23,220	26,858		3,638	50,078
Annua 1	144,202	248,139	30,594	360,635	322,301	0	497,097	497,097 609,044	237,322	349,269	1,106,141
Net		103,937		330,041	322,301			11,947		111.947	

Source: Hales (1980).

VII. LITTORAL TRANSPORT

Sources of Littoral Material

7-01 The region of coastline between the Anaheim Bay east jetty and the Newport Submarine Canyon is essentially a semi-closed system in that major sources of littoral material input are restricted to two finite locations (assuming no significant onshore movement of material from deep water by wave energy). The more significant source of material to the system is the feeder beach region at Surfside-Sunset Beach. Here, it is estimated that, on the average, approximately 360,000 cubic yards of material are placed annually.

7-02 A less significant source of material to the system is riverborne sediment transport by the Santa Ana River. The significance of this source is limited both by the volume of material transported, and by the location of the river mouth near the downcoast extremity of the littoral cell, which experiences a large downcoast movement of material in the surf zone. Any volume of material transported to the coast by the river which is less than the difference between the average annual downcoast transport of littoral material and the average annual net transport will be carried out of the system by deposition into the Newport Submarine Canyon, or placed on the continental shelf adjacent to the Canyon. No river mouth delta will form under these conditions. Only under extreme floodflow conditions on the river will significant quantities of riverborne sediment be transported to the coast sufficient for delta creation. It has been estimated by the Los Angeles District (1987) that for the period 1941-1978, sand outflow to the coast by the Santa Ana River was 80,000 cubic yards per year, on the average. The amount of sand outflow for future years without project is estimated to be only 25,000 cubic yards per year, on the average. With project, the sand outflow to the ocean for future years is estimated to increase to 36,000 cubic yards per year, on the average.

7-03 The ultimate repository for all littoral material removed from the system is the open ocean. Material which disappears from the beach will either be transported alongshore and out of the littoral cell by

movement down the Newport Submarine Canyon, or will be carried offshore by wave forces and deposited in shoal regions sufficiently far from shore to preclude returning to the nearshore zone.

Beach Materials

7-04 It is generally considered that, subsequent to the construction of the Anaheim Bay east jetty in 1944, materials comprising the dynamic surf zone portion of the beaches downcoast to the Santa Ana River mouth have originated as nourishment material placed on Surfside-Sunset Beach. The beaches between the Santa Ana River mouth and Newport Beach consist of a combination of materials, including materials placed on Surfside-Sunset Beach, riverborne sediments transported to the coast by the Santa Ana River, and by placement material used to fill the Newport Beach groin field. Sediment samples were taken from the foreshore slope and backshore of Surfside-Sunset Beach (U.S. Army Engineer District, Los Angeles, 1978) and subjected to mechanical analyses. Results of the analyses indicated that the exposed area of the beach was composed of extremely clean, predominantly medium to coarse grained sand. Those samples contained fines no greater than 2 percent. The subtidal zone of the sandy beach shoreline became more silty. The higher percentage of fines in the subtidal zone appeared to be the result of previous beach nourishment operations, although much of this fine material could have been washed by wave action from the surf zone and transported offshore. Mechanical analyses of samples taken from Surfside-Sunset Beach in 1987 also indicated a similar trend toward finer grained materials offshore (U.S. Army Engineer District, Los Angeles, 1987c).

Offshore Materials

7-05 An offshore source of beach material designated Borrow Area B for nourishing Surfside-Sunset Beach is centered 6,900 feet off Sunset Beach (U.S. Army Engineer District, Los Angeles, 1978). This source lies on the shoreward boundary of an area previously determined by the U.S. Army Coastal Engineering Research Center to contain suitable beach material. That area designated as Area A-II is approximately 7 miles long by 2 miles wide, extending from Seal Beach to Bolsa Chica State Beach. That offshore sand inventory indicated that 220,000,000 cubic yards of suitable sand exists in the area adjacent to Borrow Area B. As is characteristic of San Pedro Bay, the ocean floor encompassing Area A-II is uniformly flat and slopes an average of 0.3 percent. Within Borrow Area B, the floor is also relatively flat, varying from a minimum depth of -31 feet to -41 feet MLLW. No extreme irregularities were found to exist within this borrow area.

7-06 Exploration of Borrow Area B by Los Angeles District, (1978) indicated that the area is covered with a gray, slightly silty, medium grain sand extending to the first silt or clay stratum. These silt and clay strata vary in thickness from 6 inches to 6 feet, are laterally discontinuous, and occur at depths ranging from 3 feet to over 20 feet.

They would not be suitable for use as beach replenishment; only that sand above the first stratum would be considered suitable. The statistical average of fines is 9 percent in the available material for the total borrow area. Laterally, indications were that the shore side of the borrow area should be avoided because of the more shallow clay strata and the greater percentage of fines in the sand. The better material tends to occur seaward and toward the south corner. It was estimated that dredging a section to 20-foot depth and 1,000 feet wide from this region would produce 1.75 million cubic yards of suitable material.

7-07 A study by the University of Southern California for the State of California (Osborne, et al., 1983) defines sand borrow source materials for the offshore region of the San Pedro Littoral Cell. That study indicated that 13 test holes were drilled offshore, a distance of 3,000 to 18,000 feet between the Huntington Beach Pier and the Newport Beach Pier. A sand borrow area exists between Huntington Beach Pier and the Newport Beach Pier, with approximate dimensions of 10,000 feet by 8,000 feet and 6 feet deep, which would yield about 17,000,000 cubic yards of material. The area lies between the 35- and 130-foot MLLW contours. The upcoast and downcoast limits are 12,000 and 4,000 feet, respectively, upcoast of the Newport Beach Pier, and parallel to the shoreline. The seaward limits extend 2,500 to 12,500 feet offshore. Although that study does not provide the depth or detailed material descriptions of each hole, the study report does indicate that the sediments encountered in the test holes are either suitable or marginally fine sand that could be used for beach replenishment (Los Angeles District, 1987).

VIII. SEDIMENT BUDGET

Newport Littoral Cell

8-01 Everts (1987) noted that the southeastern one-half of the contigious San Pedro Littoral Cell also satisfies the requirements for being identified as a littoral cell, and termed this portion the Newport Littoral Cell (see fig. 6). The Santa Ana River discharges into the Pacific Ocean at about the southeastern one-third portion of the Newport Littoral Cell. Before 1899 the San Pedro Littoral Cell extended from Point Fermin to Corona Del Mar. However, since that time, the northern half of the cell has been greatly modified. Today, coastal processes north of Anaheim Bay are essentially completely controlled by artificial structures. Waves are effectively blocked by the Los Angeles-Long Beach Harbor complex breakwaters, thereby eliminating littoral sediment transport behind the structures. Sand delivery to the cell by the Los Angeles and San Gabriel Rivers has been significantly reduced by the construction of sediment impoundment and flood control structures on the rivers. The jetties at Anaheim Bay essentially eliminate all transport of littoral material from the west into the Newport Littoral Cell. Hence, the coastal processes aspects pertaining to sand supply of the Newport Littoral Cell are dominated by beach nourishment projects and the minimal supply of sediments to the coastline by the Santa Ana River (see fig. 7).

Shoreline Changes

8-02 The Newport Littoral Cell is bounded by complete barriers to the longshore transport of sand. Its western boundary consists of the east jetty to Anaheim Bay, and its eastern boundary is the west jetty to Newport Bay, although the approximately 2.5-mile section of the cell between the Newport Submarine Canyon and the west jetty to Newport Bay (the Balboa peninsula) may not be significant to an analysis of the sediment budget of the Newport Littoral Cell. The shoreline of the Newport Littoral Cell is in a state of dynamic equilibrium, with most portions of the cell oscillating about a relatively stable position.

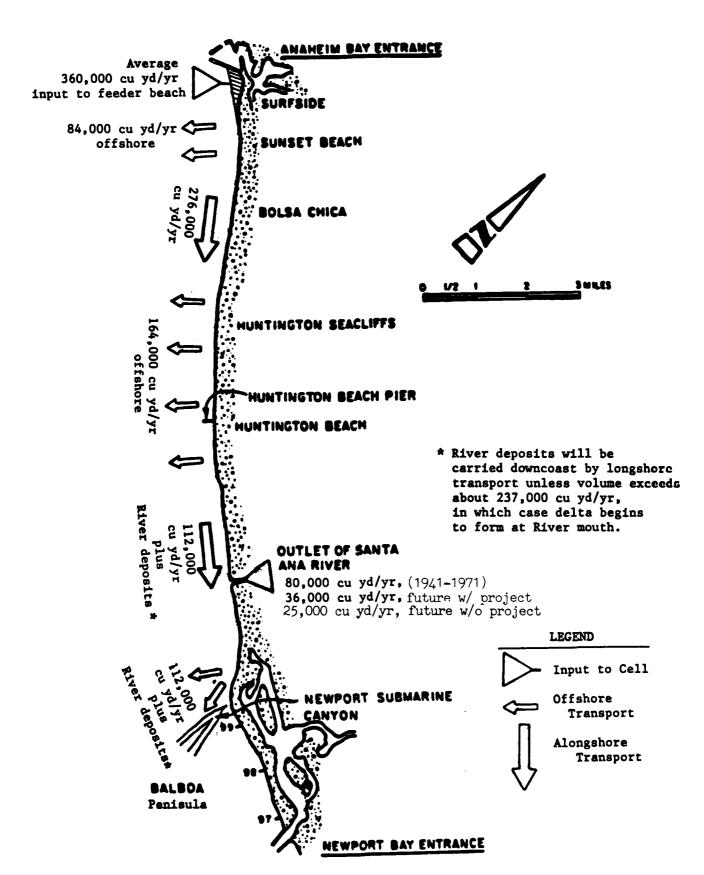


Figure 7. Sediment sources, transport paths, and sinks for Newport Littoral Cell.

The region most susceptible to shoreline change is the Surfside-Sunset Beach renourishment region, with the change being as much as 500 feet over 5- to 10-year periods between renourishment intervals. Other regions of the cell show relatively insignificant changes over long time intervals.

Newport Littoral Cell Sediment Budget

SEDIMENT SOURCES

8-03 The primary source of sediment to the Newport Littoral Cell is the feeder beach renourishment area at Surfside-Sunset Beach. Renourishment activities supply about 360,000 cubic yards per year, on the average, to the cell. A secondary source of sediment to the Newport Littoral Cell is riverborne transport by the Santa Ana River. Under previous conditions, the river contributed about 80,000 cubic yards per year, on the average. After river flood control channel improvements have been completed, the river will contribute only about 36,000 cubic yards per year, on the average.

TRANSPORT PATHS

8-04 The transport path for sediments of the Newport Littoral Cell is the surf zone which is energized by breaking waves arriving from the open ocean. For the section of relatively straight coastline from Surfside-Sunset Beach to Huntington Beach, the net downcoast transport of littoral material in the surf zone is estimated to be about 276,000 cubic yards per year, on the average. For the section of relatively straight coastline from Huntington Beach to Newport Beach groin field (past the Santa Ana River mouth), the net downcoast transport littoral material in the surf zone is estimated to be about 112,000 cubic yards per year, on the average.

SEDIMENT SINKS

8-05 Approximately 360,000 cubic yards of material is placed on Surfside-Sunset Beach each year, on the average; however, the wave climate apparently is able to transport only about 276,000 cubic yards net per year of this material downcoast. Hence, the difference between these two quantities (84,000 cubic yards per year, on the average), is probably being transported offshore to known regions of sand deposits.

8-06 The wave climate in the Surfside-Sunset Beach region is capable of transporting approximately 276,000 cubic yards net per year of littoral material, on the average. However, in the vicinity of the Santa Ana River mouth, the wave climate is capable of transporting only about 112,000 cubic yards net per year, on the average. Since no visible accumulation of sediments is occurring, the difference between these two quantities (164,000 cubic yards per year, on the average), is probably being transported offshore to known regions of sand deposits.

8-07 The net downcoast transport of littoral materials past the Santa Ana River mouth of approximately 112,000 cubic yards per year, on the average, is being lost from the littoral system, either down the Newport Submarine Canyon or onto the continental shelf to the west of the canyon where known regions of sand deposits exist. In addition to the net downcoast transport of littoral material of 112,000 cubic yards per year, the wave climate is also capable of transporting that riverborne sediment which is carried to the ocean by the Santa Ana River, as long as the sum of the riverborne sediment plus the net downcoast transport of littoral material in the surf zone does not exceed the gross downcoast transport capacity of the wave field. Hence, as long as the sediment volume carried to the Pacific Ocean by the Santa Ana River does not exceed 237,000 cubic yards per year, on the average, the wave climate will transport both the riverborne sediments and the net downcoast transport of littoral material past the Newport Beach groin field and out of the littoral system. Under severe flood conditions where riverborne sediment transport to the coast exceeds 237,000 cubic yards per year, temporal deltas and perturbations to the coastline in the vicinity of the Santa Ana River mouth will develop. Such deltas and other perturbations will dissipate as dynamic equilibrium returns to the coastline of the Newport Littoral Cell.

IX. TIDAL INLET

Existing Inlet Conditions

9-01 The recommended plan for coastal structure improvement at the mouth of the Santa Ana River includes a relocation of the Talbert Channel approximately 1,000 feet upcoast, with its base width expanded from 70 feet to 160 feet. The ocean entrance of the river will be expanded from its existing base width of 317 feet to a new base width of 450 feet, with a channel invert elevation established at -4.00 feet MLLW. The Greenville-Banning Channel will merge with the river about 1.5 miles upstream from the Pacific Ocean. To mitigate the loss of 8 acres of coastal salt marsh required for river expansion, and to preserve and enhance an 84-acre habitat for endangered bird species, the recommended plan includes the acquisition and improvement of approximately 92 acres of degraded marshland located east of the river immediately upriver from the Pacific Coast Highway. To the maximum extent possible, it is also necessary to ensure that the relocated Talbert Channel remains open to the ocean; thereby, providing tidal exchange for a proposed 17-acre marsh restoration, located north of the Pacific Coast Highway and upstream from the outlet, by Orange County. It is essential to provide tidal exchange for the planned 92-acre marsh east of the Santa Ana River by keeping the river outlet open to the ocean. The hydraulic design of the mouth of the Santa Ana River provides adequate flushing ability to maintain the tidal inlet system open from the closure effects of littoral transport in the surf zone.

9-02 The tidal range at the project site is of importance both because it will play a central role in the design of the topography and hydraulic inlet structures for the 92-acre marsh, and because it will determine the energy available for scouring littoral material from the Talbert Channel and Santa Ana River outlets during ebb tidal flow. Tidal conditions inside the river mouth at the entrance to the proposed 92-acre marsh will depend upon the extent to which the coastal tides are affected by head losses in the new channel, and by partial or total blockage of the mouth by littoral material.

Existing Tides at the Marsh Entrance

1

9-03 Tide gauge data obtained in the Greenville-Banning Channel by the Orange County Environmental Management Agency supports the conclusions that the channel outlet is frequently blocked. A small water-level fluctuation (generally less than 1 foot) occurs in the channel during closure episodes, apparently as the result of leakage through permeable areas in the intermediate jetties. When the channel is open to the ocean, the tidal range is significantly less than that which occurs along the coast. Whereas the mean tidal range at Newport Bay Entrance is about 3.7 feet, the tidal range recorded at the gauge exceeded 1.5 feet only 46 percent of the 1983-1984 period. The primary cause of the reduced tidal range in the channel appears to be a bar or "sill" at the ocean outlet which obstructs the lower portion of the tidal excursion.

Existing Tides in the Talbert Channel

9-04 Tide measurements analogous to those obtained in the Greenville-Banning Channel are not available for the Talbert Channel or the Santa Ana River. To provide preliminary information on the presence or absence of a sill across the Talbert Channel outlet, the water level upstream of the outlet was determined on 22 September 1986. Whereas the predicted low water elevation at Newport Bay Entrance was +1.0 feet MLLW, the measured water level in the Talbert Channel (1,000 feet upstream of the outlet) did not fall below +2.0 feet MLLW. It thus appears that a sill may exist at the Talbert Channel outlet, but at a lower elevation than that which obstructs the Greenville-Banning Channel outlet. This conclusion is consistent with the observation that the Talbert Channel remains open far more frequently than the Greenville-Banning Channel.

Recommended Structure Configuration

9-05 The existing jetties at the project site will be replaced by four new jetties; (a) two to stabilize the outlet of the widened Santa Ana River, and (b) two to stabilize the outlet of the relocated Talbert Channel. A training dike will also be required for the Santa Ana River outlet.

9-06 The jetty configuration at the new Talbert Channel outlet has been designed to minimize the closure frequency of the outlet while avoiding significant adverse impacts on the existing littoral transport regime. The jetties will terminate approximately 900 feet seaward of the Pacific Coast Highway, a location analogous to that of the existing northwest jetty in terms of proximity to the typical MLLW shoreline. The ability of the existing Talbert Channel to remain open suggests that the new jetties, which will also extend to the MLLW contour, will be sufficient to assist the channel outflow in penetrating the zone of beach drift.

Because the jetties will not extend beyond the present shoreline, however, they will not impound appreciable quantities of littoral material. It is anticipated that sand will bypass the new outlet in much the same manner as it bypasses the existing Talbert Channel outlet, and that the net drift of material toward the southeast will not be materially affected. The alignment of the new jetties is approximately perpendicular to the shoreline.

9-07 Potential sand migration through the proposed structure will not create the sand plug presently experienced at the mouth of the river. Both jetties and the training dike at the mouth of Santa Ana River will terminate at proximity of the MLLW contour. Most of the littoral transport occurs below this elevation. The sand plug is being created almost entirely by the material moving in the littoral zone and entering around the jetties. The small portion of the sand which will penetrate the river through the proposed permeable training dike or the jetties will easily be flushed by the tidal action.

Tidal Inlet and Tidal Exchange System

9-08 Historically, the Santa Ana River and Greenville-Banning Channel have experienced frequent closure. The existing marsh relies on a single tidal gate for exchange of tidal and riverine flows with Greenville-Banning Channel. Tidal exchange in the marsh is extremely poor and should be improved to support future marsh restoration plans. On the other hand, tidal exchange in the existing Talbert Channel has been satisfactory and should be maintained. Restoration of a 17-acre marsh adjacent to the Talbert Channel is currently being planned by others, and will rely on exchange of tidal and riverine flows with the Talbert Channel.

9-09 The tidal exchange system as shown on figure 8 was analyzed by Simons. Li, and Associates, Inc. (1987). It included the following: (a) Training Dike No. 1, to provide a 90-foot channel in the proposed Santa Ana River to prevent littoral sedimentation which may result from channel widening; (b) Training Dike No. 2, located in the middle of the proposed Talbert Channel to retain the self-cleaning capability of the existing Talbert Channel; (c) Tidal Gate No. 1, located on the Santa Ana River east bank above the Pacific Coast Highway to have a similar function as the existing gate; (d) Tidal Gate No. 2, located on the Santa Ana River east bank near the upper end of the proposed 92-acre marsh to provide additional flow exchange to the marsh; and (e) Tidal Gate No. 3, located at the confluence of the proposed Santa Ana River and existing Talbert Channel to provide tidal exchange between the proposed Santa Ana River and the proposed Talbert Channel.

9-10 Because of potential tidal exchange through Tidal Cate No. 3 and the existing Talbert Channel between the proposed Santa Ana River and the proposed Talbert Channel, both the 92-acre marsh and the 17-acre marsh have an auxiliary system to provide tidal or riverine flows, if the primary system fails to function due to unexpected closure of either outlet.

9-11 Performance of the proposed tidal exchange system was carefully evaluated and a general guideline for operation and maintenance was recommended by Simons, Li, and Associates, Inc. (1987). With the proposed training dike structures, the sediment flushing capability and the river mouth opening potential of Santa Ana River and Talbert Channel are comparable with the existing Talbert Channel. The tidal ranges in the Santa Ana River and Talbert Channel near the proposed 92-acre marsh and the 17-acre marsh will be increased when compared to the existing condition. With the proposed Tidal Gates Nos. 1 and 2, and the conceptual 92-acre marsh restoration plan, the tidal range and flow circulation in the marsh can be significantly improved.

9-12 Training Dike No. 2 (located in the Talbert Channel) may be deferred in construction to reduce initial cost, and to allow for observation of performance of remaining aspects of the tidal exchange system. This dike is not as effective as Training Dike No. 1 in increasing the sediment flushing capability of the proposed channel. The requirement and location of this dike can be determined based on field observation following channel construction. During the observation period, tidal exchange may be provided through the proposed Santa Ana River system (with Training Dike No. 1 and Tidal Gate No. 3). If there is a tendency for Talbert Channel to close, construction of Training Dike No. 2 should proceed immediately.

X. SANTA ANA RIVER JETTY DESIGN

10-01 The design of improvements recommended in this appendix is based upon standard engineering practice, consultations with specialists in coastal engineering oceanography and geology, and technical references listed at the end. Plan, profile, and sections of the jetties are shown on plate 1.

General

10-02 Rubble-mound jetties are selected as replacement for the existing rubble-mound jetties in the Santa Ana River mouth. The rubble-mound jetties would be acceptable to Orange County for esthetical and safety aspect, and the character of the shoreline. Other factors for selecting rubble-mound structures for the Santa Ana River jetties are the availability of material, acceptable performance, depth of water, wave action, exposure to the ocean, and construction costs.

Stability Coefficients

10-03 Stability coefficients (K_D) are dimensionless coefficients used in the determination of the weight of armor units of rubble structures. A rubble structure is composed of several layers of random-shaped and random-placed stones, and is protected with a cover layer of selected armor units of either quarrystone or specially shaped concrete units. Relatively satisfactory experience with the existing Santa Ana River jetty design at the Pacific Ocean outlet has provided guidance for the design of proposed channel improvements in this region. The design of the ocean outlet includes jetty head and structure sections comprised of rough angular quarrystone, with random placement of two units of thickness in the armor layer. For the structure head section designed to withstand breaking waves of 14 sec., 9 ft. height, the stability coefficient, K_D is 1.6; for the structure trunk to withstand the same design breaking wave, the stability coefficient, K_D , is 2.0. Upriver from east jetty station 10+30 (west

jetty sta. 9+60), non-breaking waves are expected immediately after construction of the flood control channel. However, after normal shoaling created by riverborne and littoral sediment transport accumulates in the excavated channel section breaking of waves on this section with heights less that the design 9 feet wave height may occur. Hence, the stability coefficient for a breaking wave condition should still be utilized in this section of rubble structure ($K_D = 2.0$) even though the maximum broken wave height will not exceed approximately 5 feet in height.

Side Slope

10-04 The flatter the side slope of a rubble mound structure, the more stable the slopes will be. Side slopes should not be steeper than 1V on 1.5H. Based on empirical knowledge obtained from historical experience with similar rubble structures under corresponding wave and tide conditions, structure head slopes of 1V on 2H have been found to be satisfactory, particularly in light of the fact that this slope is then utilized in conjunction with the appropriate stability coefficient K_D , to determine the stable armor stone size. That is, a change in structure head slope requires a compensating chance in stability coefficient, K_D , to determine the stable armor stone size. Based on previous experience, the slopes of the head sections of the Santa Ana River jetties from west jetty station 7+90 to station 9+60 (east jetty stas. 8+60 to 10+30) should be 1V on 2H in order to provide greater assured resistance to forces from the design wave breaking directly on the seaward end of the structure.

10-05 Upriver beyond the rubble structure head section above west jetty station 9+60 (east jetty sta. 10+30), the side slopes of the jetty structure trunk actually constitute the side slopes of the flood control channel, and the armor stone also functions as channel riprap. The stability of riprap bank revetments is affected by the steepness of channel side slopes. Side slopes on which stone is placed by machine or dumped should not be steeper than 1V on 2H (EM 1110-2-1601, Engineering and Design: Hydraulic Desigh of Flood Control Channels, 1 July 1970). Hence, the 1V on 2H side slopes utilized for the rubble structure jetty head section will be continued for the structure trunk section upriver between the head section and the transition section from the rubble jetty structure to the flood control channel.

Crest Elevation

10-06 The crest elevation of the Santa Ana River flood control channel levee has been established at +11.0 feet MLLW (+8.1 feet MSL) at the outlet of the channel. This results in the head section of the flood control channel having a freeboard of 4.5 feet for the design flood.

10-07 Overtopping of rubble structures such as the Santa Ana River flood control channel terminating jetties can be tolerated only if it does not cause damaging conditions behind the structures. Whether overtopping will occur depends on, among other things, the wave characteristics of height and period, and the maximum tide level. For design SWL = +7.0 feet MLLW, and a design wave at the structure of 14 sec., 9 ft. height, minor overtopping of the jetties will occur at these extreme wave and tide conditions. The design wave arriving at the design SWL will overtop the seaward end of the jetties by about 0.5 feet. The frequency of occurrence of such an event is extremely low and, additionally, such overtopping will not cause damage to the structure or otherwise adversely affect the flood control channel or other adjacent structure or feature of the landscape. Such minor overtopping may not only be tolerated, it is conceivable that such overtopping will actually be beneficial by allowing wave overflow to backwash fillet formation sand around the tips of the jetties and be transported back into the littoral system.

10-08 Hence, considering the low frequency of occurrence of a minor amount of overtopping which may be actually beneficial, the crest elevation of the terminating jetties of the Santa Ana River flood control channel at the Pacific Ocean is considered to be +11.0 feet MLLW (+8.1 feet MSL).

Armor Stone

10-09 The capstone forms the protective covering of the jetties and covers the corestone, the seaward end, and both sides of the jetties. Capstone weight, crest width, and layer thickness are important factors in the stability of the primary cover layer. The minimum weight requirement for individual capstones is based on the stability formula for rubble-mound structures as follows:

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot a}$$

Where: W = Weight of armor unit in primary cover layer, pounds

Wm = Unit weight of armor unit, pounds/cubic foot

H = Design wave height measured at the location of the proposed structure, feet

 S_r = Specific gravity of armor unit relative to sea water

a = Angle of jetty slope measured from horizontal, degrees

 K_D = Stability coefficient.

The minumum required weight for individual capstone, Class A, for a design wave of 9 feet high, a $\rm K_D$ of 1.6, a slope of 1V on 2H, and a unit weight of stone of 160 pounds per cubic foot, is 5 tons. Therefore, the armor stones between west jetty stations 7+90 and 9+60 (east jetty stas. 8+60 to 10+30) can range from about 4 to 6 tons, with about 50 percent of the individual stones weighing more than 5 tons. The armor stone layer thickness is 8 feet and the crest width is 12 feet. Further up the channel between west jetty stations 9+60 and 11+90 (east jetty stas. 10+30 to 12+60), the weight of individual capstone should be 3 tons and the layer thickness 6 feet. Between west jetty stations 11+90 and 13+52 (east jetty stas. 12+60 to 14+22) the weight for individual capstone should be 2 tons and the layer thickness 5 feet. The crest width remains 12 feet along the jetties.

10-10 The proposed jetty stone size is larger than the existing. Design wave analysis of the Santa Ana River jetties and the training dike resulted in the breaking 9 feet wave height. According to the Hudson formula a 5-ton armor layer is required for stability of the structures. Design wave conditions are constrained by a depth limited breaking wave height. The 14 feet of water depth results from a +7 feet (MLLW) tide and scour elevation to -4 feet (MLLW) which is also a design invert elevation. Offshore wave conditions which can produce the 9 feet breaking wave height can occur several times a year and are typically associated with the winter storm season when maximum scour elevations are expected. Therefore, it is believed that the 5-ton size stone is justified.

Corestone

10-11 Class B stone will be used as corestone to form a dense compact mound to support the cap stone. In accordance with SPM (1984), the weight of the corestone is approximately one tenth the weight of the cap stone units. The corestone is not subject to eroding forces from wave action and will have the following gradation:

Weight of Pieces, Pounds	Percent by Weight Smaller Than
1,000	100
500	80-95
200	40-60
50	5 - 25
10	0-5

Bedding Layer

10-12 A bedding layer is used to protect the foundation of the rubble-mound jetties from scour and migration. The bedding layer prevents erosion during and after construction by dissipating forces from horizontal wave, tide, and longshore currents. A one-foot thickness is allowed to assure that bottom irregularities are completely covered.

An additional one-foot thickness is required to compensate for disturbance by placement of larger stones, for a total bedding layer thickness of 2 feet. The bedding stone will be quarry waste material, reasonably well graded with the limits specified below.

Weight of Pieces, Pounds	Percent by Weight Smaller Than
50	100
30	40-60
10	20-40
1	0-20

Toe Protection

10-13 Toe protection for the head of the Santa Ana River jetty was designed against maximum scour force based on the following two conditions, outlined in SPM (1984). The first condition is the occurrence of water depth at the toe that is less than twice the height of the maximum unbroken wave height. The estimated maximum unbroken wave height is about 8 feet. The water depth at the toe at a stillwater level of +7 feet is about 11 feet and, therefore, is less than twice the maximum unbroken wave height of 16 feet. The second condition that requires maximum scour force protection is a structure wave reflection coefficient, x, that equals or exceeds 0.25, which is generally true for slopes steeper than about 1V on 3H. The seaward slope of the Santa Ana River jetty is about 1V on 2H and therefore, the reflection coefficient, x, would exceed 0.25.

10-14 As a result, the two conditions in the Shore Protection Manual (1984) govern. The toe protection would have a layer two stone thick of stone weighing about one-thirteenth the weight of the primary armor stone. The toe protection would be 2 feet thick and the weight of the minimum toe protection stone will be about 400 pounds. The width of the toe protection would be 4 feet.

Scour Protection

10-15 The riprap to protect against channel scouring caused by floodflows was designed in accordance with procedures in appendix IV of EM 1110-2-1601 for scour. The riprap against scouring will have a thickness of 5 feet, a slope of 1V on 2H and will extend 10 feet below the flood control channel invert. The stone size W_{50} will be 700 pounds and will range from 2,800 to 90 pounds. The riprap would be connected to the armor stone that will be extended one stone thick (2 feet) into the invert of the channel improvement.

XI. SANTA ANA RIVER - TRAINING DIKE DESIGN

General

11-01 Plan, profile, and sections of the training dike are shown on plate 2. The training dike is designed in accordance with the design criteria and engineering assumptions used in the design of the Santa Ana River jetties. The design wave at the ocean end of the training dike is the 14 seconds, 9 feet breaking wave. The stability coefficient, K_D , is 1.6 for the structure head and 2.0 for the structure trunk.

Side Slopes and Crest Elevation

11-02 The side slopes are 1V on 2H. The crest elevation varies from +5.0 feet MSL at the structure head to +3.0 feet MSL at the end of the training dike. The crest elevations are designed to the elevation of the existing sand plug in the river mouth.

Armor Stone

11-03 The armor stones for the training dike are 5 tons and can range from about 4 to 6 tons, with about 50 percent of the individual stones weighing more than 5 tons. The armor stone layer thickness is 8 feet and the crest width is 12 feet.

Corestone

11-04 Class B stone will be used as corestone to form a compact mound to support the capstone. The corestone would not be subject to eroding forces from wave action and will have the following gradations.

Weight of Pieces, Pounds	Percent by Weight Smaller Than
1,000	100
500	80-95
200	40-60
50	5 -2 5
10	0-5

Bedding Layer

11-05 The bedding layer to protect the foundation of the training dike from undermining will be 2 feet thick. The bedding stone will be quarry waste material, reasonably well graded with the limits specified below.

Weight of Pieces, Pounds	Percent by Weight Smaller Than
50	100
30	40-60
10	20-40
1	0-20

Toe Protection

11-06 Toe protection for the head of the training dike was designed against maximum scour force used for the Santa Ana River jetties.

11-07 The toe protection will have a layer two stone thick of stone weight about one-thirteenth the weight of the primary armor stone. The toe protection will be 2 feet thick and the weight of the toe protection will be about 400 pounds. The width of the toe protection will be 4 feet.

Scour Protection

11-08 The riprap to protect against channel scouring caused by floodflows was designed in accordance with procedures in appendix IV of EM 1110-2-1601 for scour. The riprap will have a thickness of 5 feet, a slope of 1V on 2H and will extend 10 feet below the flood control channel invert. The stone size W_{50} will be 700 pounds and will range from 2,800 to 90 pounds. The riprap will be connected to the armor stone that has been extended one armor stone thick (2 feet) into the invert of the channel improvement.

XII. CONSTRUCTION MATERIALS

Sources of Stone

12-01 Sufficient quantities of suitable stone will be available from the existing structures and from privately owned quarries mostly located near Riverside and Corona, California. The unit weight of stone from these quarries ranges from about 164 to 175 pounds per solid cubic foot, and a unit weight of 160 pounds per solid cubic foot was used in the jetty design. Recent laboratory quality compliance tests have been made on stone samples from selected quarries in connection with several other similar Corps of Engineers projects. Although the majority of the stone sources tested have produced acceptable stone in the past, it cannot be assumed that they will continue to do so. Therefore, any stone source considered for use as slope protection, either a quarry or existing structure, will require further field inspection and evaluation and may require additional quality compliance testing prior to stone placement. A list of potential stone sources for which recent laboratory test results are available is shown in the Geotechnical Appendix.

Existing Stone

12-02 Approximately 27,000 tons of Class A, 8,000 tons of Class B, and 24,000 tons of Class C quarry stones were used during the construction of the Santa Ana, Talbert, and Greenville-Banning jetties in 1958 by the Orange County Flood Control District. The weight of the Class A stone, in general, ranged between 0.5 and 3 tons each, with 50 percent by weight not less than 1,500 pounds nor more than 3 tons each. The minimum weight of the Class B stone was 200 pounds, each, and not less than 50 percent by weight of the Class B stone weighted between 600 and 1,500 pounds each. The Class C stone was used for invert and embankment paving and the stone pieces ranged from 8 to 30-inches. Wherever possible, the three grades of stones will be salvaged for the construction of the jetties.

XIII. RECOMMENDED PLAN - MOUTH OF SANTA ANA RIVER

13-01 The recommended plan for the coastal features consists of (1) Santa Ana River jetties to form the ocean entrance of the flood control channel and (2) a training dike to provide an ocean inlet for tidal exchange between the ocean and 92-acre salt marsh. The recommended plan is shown in figure 8.

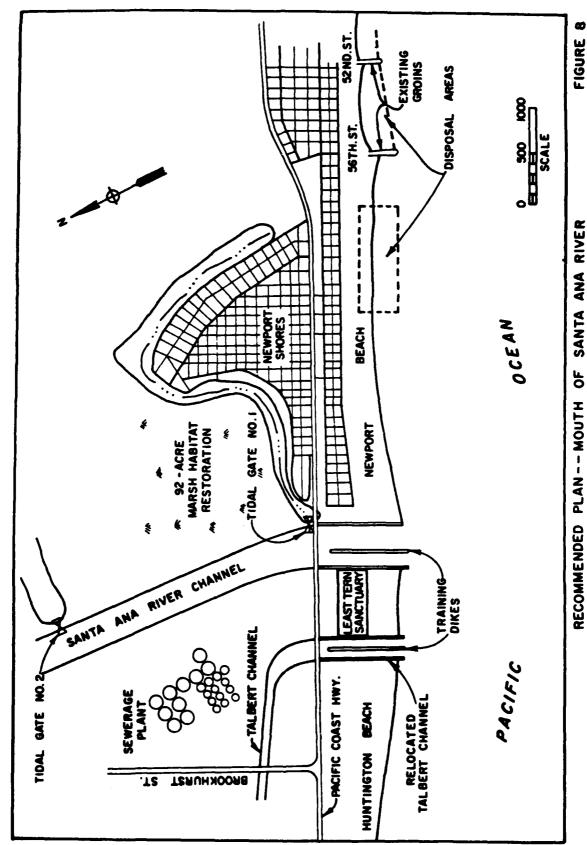
13-02 The Santa Ana River jetties will begin at approximately the same location as the existing jetties (MSL). The two jetties will extend upstream along the river about 500 feet. The Santa Ana River jetties will increase the existing river width from 317 to 450 feet. The existing Talbert Channel will be relocated by local interests on the upcoast end of the Least Tern colony nest.

13-03 The 850-foot-long training dike will be constructed in the river, paralleling the Santa Ana River west jetty. The dike and the west jetty will form a 90-foot wide trapezoidal ocean inlet to provide for tidal exchange between the Santa Ana River and the 92-acre Saltmarsh, should the river mouth shoal. The trapezoidal ocean inlet will have a sediment cleaning capability to remain open, about 2.5 times greater than the existing Talbert Channel, based on studies by Simon, Li, and Associates (1987).

13-04 Consideration was given to constructing the Santa Ana River jetties about 140 feet south of the recommended alignment to avoid the State Beach. However, the plan was not considered feasible because it would remove 12 residences and would eliminate about 9 acres of marsh land for the 92-acre Saltmarsh restoration project. In addition, the existing Pacific Coast Highway bridge would have to be lengthened 140 feet.

Access Road

13-05 Adequate road access exists for the construction of the Santa Ana River jetties and the training dike via the Santa Ana River.



RECOMMENDED PLAN -- MOUTH OF SANTA ANA RIVER

B-XIII-2

Disposal of Channel Material

13-06 Approximately 4,260,000 cubic yards of material will be excavated from the Santa Ana River during construction of the flood control channel. It is estimated that out of this amount about 2,750,000 cubic yards could be utilized for beach nourishment. During the initial stage of construction, approximately 1,384,000 cubic yards will be removed from the first reach, which extends about two miles up the channel. It is proposed to place 1,000,000 cubic yards of this material within the Newport groin field, filling the cells up to capacity. The remaining 384,000 cubic yards could be used to nourish the beach about 2,000 feet down coast from the mouth of the river.

13-07 Stage two construction will excavate approximately 1,367,000 cubic yards of material from the second reach, which extends up to 5 miles up the river channel. Depending on the time and the wave conditions between these two stages of construction, material placed between the groins and on the beach will be partially depleted due to the coastal processes. Therefore, placement of the material during the first stage of construction can be repeated for the second stage.

Operation and Maintenance

13-08 The existing rubble-mound jetties at the Santa Ana River mouth have sustained little or no damage over the 28-year period they have been in service (1958-1986). Since the new jetties will utilize a larger capstone and will not be exposed to larger waves, very little maintenance is expected. A damage criteria of 0 to 5 percent of the cost of the capstone is used to determine the maintenance cost over the 50 years of the structure life.

XIV. EFFECT OF THE RECOMMENDED PLAN ON THE SHORELINE AND TIDAL INLET

General

14-01 The major improvements contemplated for the Santa Ana River flood control channel from Prado Dam to the Pacific Ocean have the potential for influencing coastal processes at the river mouth from three different aspects.

- a. The enlargement of the flood control channel by the excavation of over 4,000,000 cubic yards of material will affect the outflow of sediment transported to the coastline under floodflow conditions as aggradation within the channel will be influenced following construction, and for that period of time until equilibrium conditions have reestablished.
 - b. The excavated material must be disposed at either:
 - (1) upland disposal sites.
 - (2) in the open ocean,
 - (3) utilized as beach nourishment if suitable, or
 - (4) by combinations of the first three possibilities.

Disposal of large quantities of material in the open ocean or utilization as beach nourishment material by placement on beaches either upcoast or downcoast of the river mouth may affect potential for closure of the river mouth by wave transport of littoral material.

c. The physical location of the oceanward termination of the rubble jetties for stabilization of the location of the improved Santa Ana River will influence the asymptotic orientation of the shoreline upcoast and downcoast of the river mouth.

Santa Ana River Sediment Transport

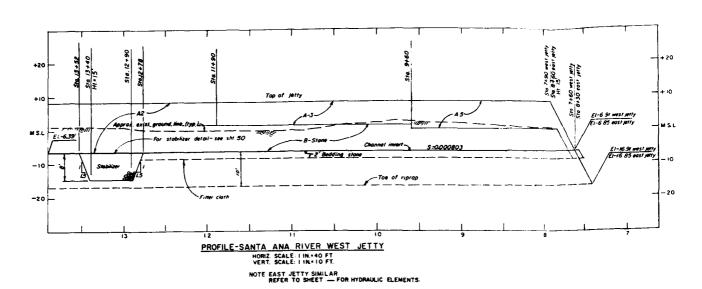
14-02 For the period 1941-1971, an estimate of the coarse sediment discharge by the Santa Ana River was made by Kroll (1975). This estimate was adjusted by the Los Angeles District (1987a) by including sediment outflow to represent the period up to 1978. The estimated average annual sand deposition in the river channel under existing conditions was 60,000 cubic yards per year, and the estimated average annual sand outflow to the ocean under existing conditions during 1941-1978 was determined to be 80,000 cubic yards per year. Under with project conditions, the average annual channel deposition and sand outflow to the Pacific Ocean were estimated to be 31,000 and 36,000 cubic yards per year, respectively. The without project average annual deposition and sand outflow to the coastline were estimated to be 24,000 and 25,000 cubic yards per year, respectively. Hence, the with project condition (from mathematical projections into the future) will increase the quantity of coarse sediment to the coastline by 11,000 cubic yards annually when compared to the without project condition (also computed in the same manner).

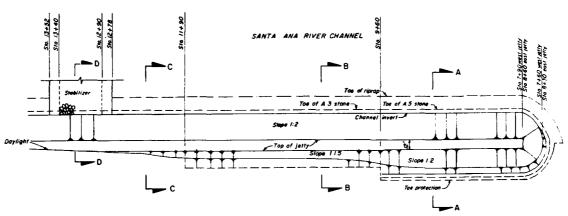
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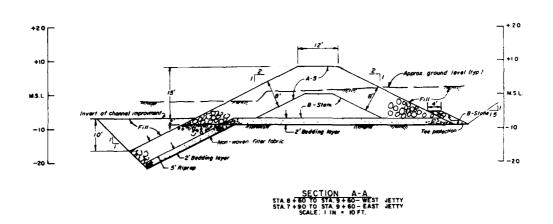
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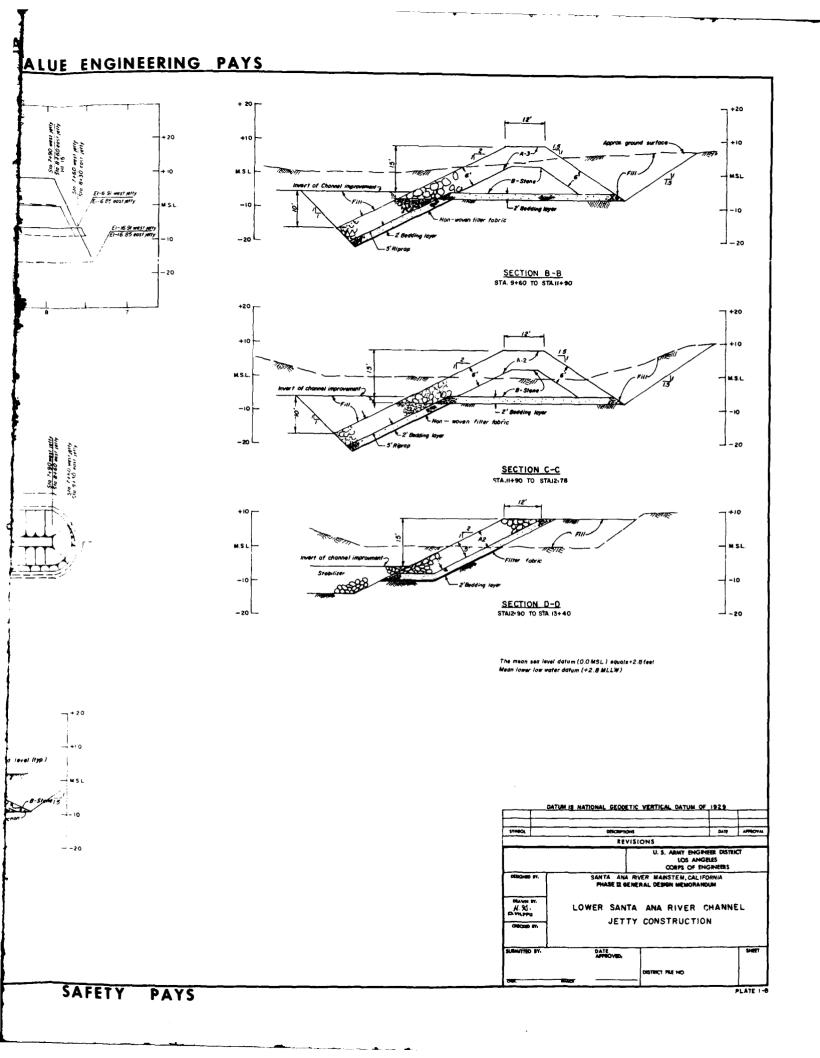




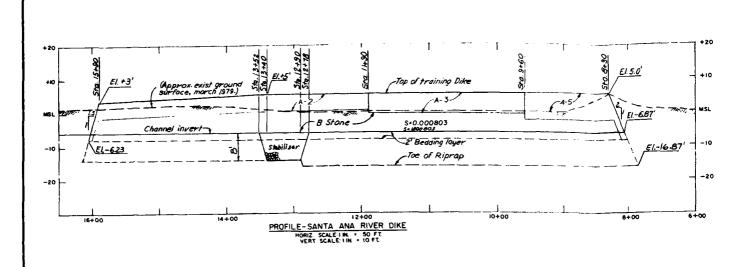
PLAN-SANTA ANA RIVER WEST JETTY

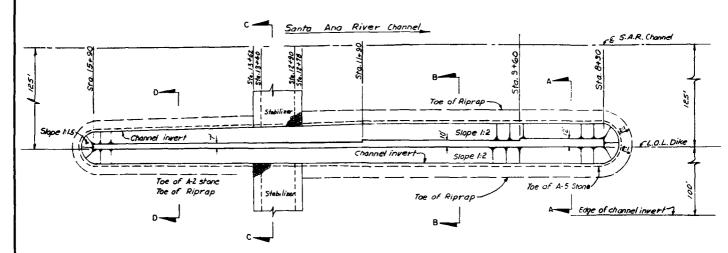
NOTE WEST JETTY SHOWN, EAST JETTY SIMILAR



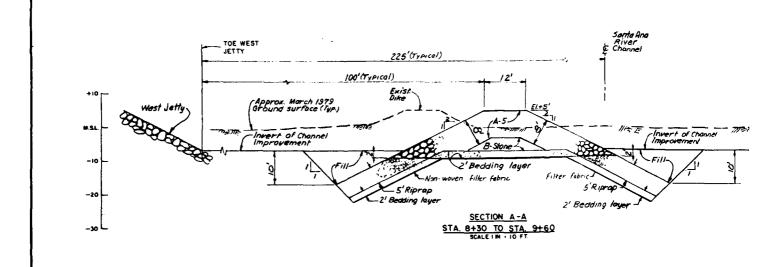


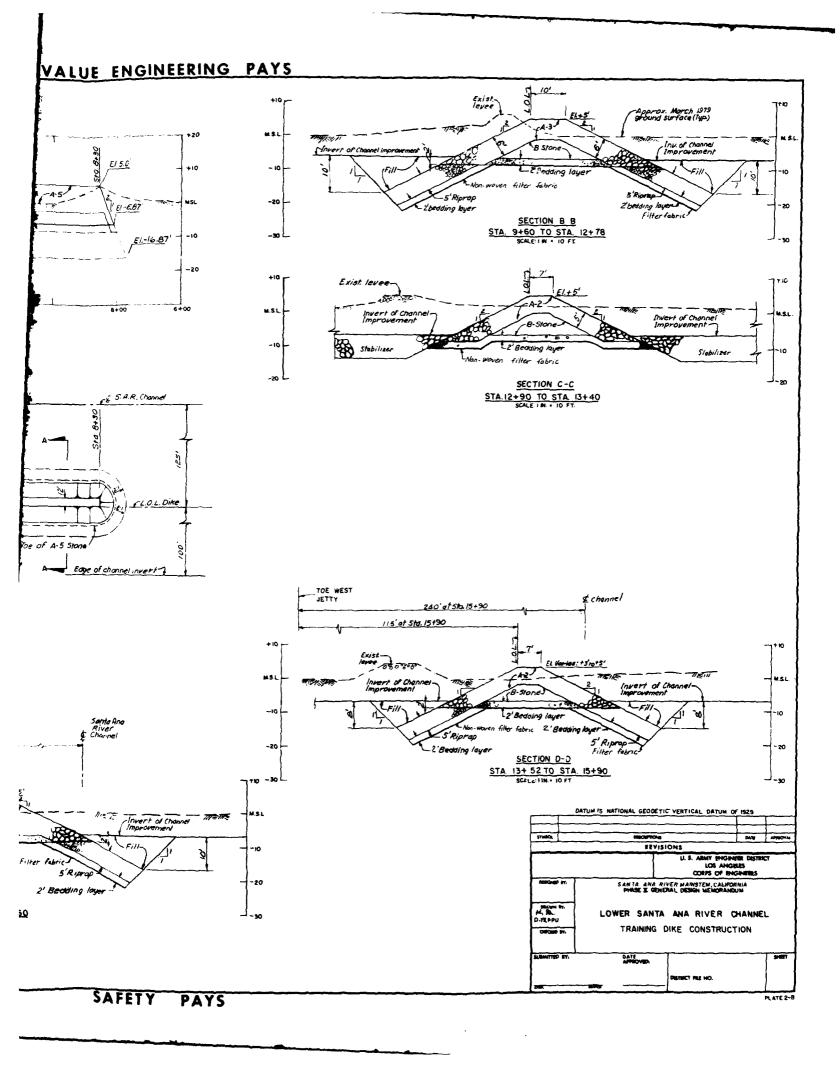
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PLAN-SANTA ANA RIVER DIKE SCALE. IIN - 50 FT.





C Sediment Transport Analysis

APPENDIX C

Sediment Transport Analyses Lower Santa Ana River

Appendix C contains three reports. The first report - Main Report-discusses the entire sediment transport analysis using the Phase I GDM channel configuration. The second report is an independent review; which was requested by the Office of the Chief of Engineers. The third report is an addendum to the main report describing the sediment analysis for a trapezoidal channel configuration.

EXECUTIVE SUMMARY

The sediment transport study for the Lower Santa Ana River consists of a complex linking of a large number of basic steps. The executive summary capsulizes how the steps link together and describes the final results.

Main Report

The hydraulic design of the proposed Santa Ana River flood control channel improvement was analyzed to ensure that the channel would function properly under anticipated sediment loads during the design flood and more frequent floods. The study reach extends approximately 31 miles from Prado Dam to the Pacific Ocean and is otherwise referred to as the Lower Santa Ana River (LSAR). The study reach of the LSAR under project conditions was subdivided into four distinct reaches. The four reaches are identified as the canyon reach, drop structure reach, concrete channel reach, and the soft-bottom channel ocean reach. The latter three reaches comprise the proposed channel improvement approximately 24 miles long (referred to in text as the improved channel). Santiago Creek is the only significant tributary and it enters the LSAR approximately 11 miles upstream of the Pacific Ocean. Specifically, the proposed channel was analyzed to: (1) identify reaches of aggradation and degradation; (2) determine channel design requirements to accommodate scour/deposition by the design flood in terms of flow capacity in reaches of aggradation and invert stabilization in reaches of degradation; (3) assess the long term deposition for operations and maintenance requirements of the channel; and (4) assess the long-term sand outflow to the Pacific Ocean. A summary of the sediment analysis follows:

Data collection efforts turned up maintenance records that indicate the average annual sediment deposition in the study reach is 55,000 cubic yards per year. Aerial photos were available for 1982, 1974, and 1938. Bed material analysis indicates about 90 percent sand and 10 percent gravel. Channel surveys were performed after the 1978 and 1980 flood events. Project channel geometry was taken from the Phase I GDM.

Streamflow data was recorded below Prado Dam, at Imperial Highway, at Ball Road and at Fifth Street. Suspended sediment measurements were also made at these gauging sites. The gauge measurements were corrected to account for the unmeasured sediment load.

A qualitative analysis using the Lane relationship indicated that the drop structure reach will experience aggradation; the area just upstream from the Santiago Creek confluence will remain stable; the all concrete reach will flush sediments through maintaining its design invert elevation; the channel ocean reach downstream from the San Diego Freeway will experience deposition.

An equilibrium slope analysis using Yang's equation yields general results similar to the qualitative analysis. It was determined that bed armoring would be unlikely during the design flood due to the relatively small representative grain size. The armor grain size is between 10 and 70 mm. The $d_{Q\bar{S}}$ grain size, however, is 2 mm.

A limiting degradation slope was estimated using four different methods: Schoklitsch bedload equation, Meyer-Peter Muller bedload equation, Shields diagram, and Lane's critical tractive force method. These methods yielded limiting degradation slopes of 0.000029, 0.000029, 0.0000073, and 0.000004, respectively which are milder than the design slopes.

A relationship between sediment discharge and water discharge was developed. The relationship incorporated all sediment sources in the canyon reach upstream from the proposed project inlet at Weir Canyon Road. Stream gauge data was available for sediment loads for discharges up to 14,000 cfs. The computer program HEC-6 was used to estimate sediment loads for higher discharges. Tatum's method was used to estimate sediment yield from the canyon watershed during a design storm. Bank erosion estimates were made by examining aerial photographs. The Pacific Southwest Inter-Agency Committee method and the Flaxman method were also used to estimate sediment yield. sediment yield rate of 1.64 acre-feet/square-mile/year was determined for the canyon watershed between Prado Dam and the improved channel reach. This yield rate compared well to reservoir deposition data indicating a 1.45 acre-feet/square-mile/year sediment yield rate at nearby Santiago Reservoir. An average annual sediment inflow of up to 132,000 cubic-yards/year was determined to enter the improved channel reach. This value includes sand, silt, and clay sizes.

Sedimentation analysis was carried out using the Corps of Engineers' computer program HEC-6 and a WES modified version known as H6NBS36. The geometric data covered the project inlet at Weir Canyon Road to its outlet at the Pacific Ocean. The program was calibrated using data from the flood of 1978. Yang's unit stream power method was used as a transport function in HEC-6. The calibration was performed by adjusting the Manning's "n" value of each section until agreement was obtained between computed and observed bed changes. The calibrated data set was verified using records from the 1980 flood. The bed changes were reproduced fairly well except for the reach downstream from the Santiago Creek confluence. In this reach, computed degradation was less than the

degradation observed during the 1980 flood. The degradation was attributable to finer bed material found only in this reach. The HEC-6 model would not be affected by this fine material since this reach under project conditions calls for a concrete-lined channel.

The data set for the project condition was developed from plans in the Hydraulic Appendix in the Phase I GDM. Grain size analyses were performed throughout the study area and a single representative grain size distribution was used (pl. 3). The project condition was evaluated using balanced hydrographs representing 10-, 25-, 50-, and 100-year frequency flood events as well as the design event. The following roughness values were used for the project condition: n = 0.02 for the downstream channel ocean reach, n = 0.015 for the concrete lined middle reach, n = 0.025 for the drop structure reach. Form drag caused by bed forms was included in the development of "n" values.

The design flood was simulated for the project condition using the HEC-6 computer program. Two different inflowing load curves were used to encompass maximum streambed changes in terms of maximum deposition and scour. The results indicate that deposition of up to 2.2 feet will occur in the upstream subreach of the drop structure reach. Deposition of up to 7.3 feet will occur in the downstream portion of the concrete reach extending into the channel ocean reach. A second simulation using clear water inflow at the improved channel inlet indicated 6 to 8 feet of scour in drop structure reaches. This worst case erosion scenario was used to estimate toe depths of lined banks.

A sensitivity analysis was performed to account for the uncertainties involved in sedimentation analysis. The Manning's "n" value was increased to 0.03 in all reaches. This had only a small effect on computed bed changes. The D_{50} grain size of the bed material was increased from 0.5 mm to 0.75 mm but this also had little effect on the computed results. A sand plug often forms at the Santa Ana River mouth during the summer months. Analysis shows that the sand plug would wash out before the peak of the design flood. An antecedent flow of 5,000 cfs for 30 days resulted in twice as much deposition near the river mouth during the design flood event. A tidal elevation of 2.54 MHHW feet was used for the downstream boundary condition for the design event. Variations in the tidal elevation had little effect on the riverbed near the ocean.

The incremental probability method was used to compute the average annual sand outflow to the ocean and the average annual deposition for the with and without project conditions. The results indicate that 31,000 (with project) and 24,000 (without project) cubic yards of sand per year deposited in the channel reach. The sand outflow to the beach was 36,000 (with project) and 25,000 (without project) cubic yards per year. From gauge records, it was estimated that the sand outflow to the ocean is 80,000 cubic yards per year. It was estimated that the frequency of maintenance in the channel ocean reach would be approximately every 20 years. No maintenance is expected in the concrete and drop structure reaches.

Addendum Report

An additional sedimentation analysis was conducted using the HEC-6 program to determine channel bed profiles for the redesigned channel. The geometric configuration of the channel was changed from a rectangular to a trapezoidal channel in the channel ocean and concrete channel reach. The HEC-6 analysis was performed using similar floods and procedures described in the main report.

The design flood simulation was computed with HEC-6 using two different inflowing loads curves to encompass maximum streambed changes. The results for high sediment inflow indicate general deposition of up to 7.5 feet will occur in the concrete channel reach extending into the channel ocean reach. The second simulation with zero inflowing load at the concrete channel inlet indicates general scour 9 feet below design invert in the channel ocean reach. Results of scour in the drop structure reach were the same as in the main report.

The incremental probability method was applied in the redesigned channel reach to compute average annual deposition and sand outflow. The results indicated deposition in the concrete and channel ocean reach of 37,000 cubic yards per year. The sand outflow was 30,000 cubic yards per year. Based on the upper grade limit in the main report, the estimated frequency of sediment removal maintenance is once every 18 years.

Sediment Transport Study Results

The sediments transport results used for the hydraulic design in terms of the top of and toe of levees were derived from the trapezoidal channel analysis (Addendum Report) for the channel ocean and concrete channel reaches and from the main report analysis for the drop structure reach. The combined results of both studies for project condition are summarized as follows:

- 1. Plates 2A and 3A shown in the addendum report display the design streambed profile with and without sedimentation, respectively. The water surface profile to determine top of levee was computed by applying the design sedimentation slopes in reaches of aggradation and the design slope in the other reaches.
 - 2. The design of levee toe depth for general scour is:

Minimum Toe Depth Below	Reach
Design Invert (ft)	Phase II Stationing
8	1204+20 - 1156+60
5	1156+60 - 535+00
10	150+50 - Ocean Outlet

3. Plate 14 of main report titled "Upper Sediment Level Sta. 8+50 to 223+35", displays the allowable sediment deposition. Long term average annual deposition is estimated at 37,000 cubic yards per year.

Frequency of sediment removal is once every 18 years. No sediment removal maintenance is anticipated in the upper portion of the concrete channel and in the drop structure reach.

4. Project sand outflow over project life is estimated at 30,000 cubic yards per year.

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Attachments

- Attachment 1 Final report "Review of the Draft Sedimentation Report of the Lower Santa Ana River, Phase II General Design Memorandum", Simons, Li & Associates.
- Attachment 2 Addendum report to the sediment transport analysis.

1. INTRODUCTION

Study Objectives

1-01 The hydraulic design of the proposed Santa Ana River flood control channel improvement was analyzed to ensure that the channel would function properly under anticipated sediment loads during the design flood and lesser frequency floods. The study reach extends approximately 31 miles from Prado Dam to the Pacific Ocean, otherwise referred to as the Lower Santa Ana River (LSAR). The study reach of the LSAR under project conditions was subdivided into four distinct reaches. The four reaches are identified as the canyon reach, drop structure reach, concrete channel reach, and the soft-bottom channel ocean reach. The latter three reaches comprise the proposed channel improvement approximately 23 miles long (referred to in text as the improved channel). Santiago Creek is the only significant tributary and it enters the LSAR approximately 11 miles upstream of the Pacific Ocean. Specifically, the proposed channel was analyzed to: (1) identify reaches of aggradation and degradation; (2) determine channel design requirements to accommodate scour/deposition by the design flood in terms of flow capacity in reaches of aggradation and invert stabilization in reaches of degradation; (3) assess the long term deposition for operation and maintenance requirements of the channel; and (4) assess the long-term sand outflow to the Pacific Ocean.

Scope of Work

1-02 The analysis of the sediment transport conditions includes the following major tasks:

- 1. Collect and evaluate available data including such items as historical channel conditions, stream gauge records, bed sampling, and aerial photography.
- 2. Determine the sediment inflow into the improved channel from the Lower Santa Ana River tributaries for the design flood as well as from the long term runoff patterns.

- 3. Analyze the sediment transport scour/deposition in the proposed project for the design flood.
- 4. Determine the average annual sediment deposition in the project reach and sand outflow to the Pacific Ocean.
- 5. Identify and design any required mitigation measures.

Description of Existing River Conditions

1-03 The portion of the river considered as the Lower Santa Ana River extends from the Pacific Ocean upstream about 31 miles to Prado Dam (see pl. 1). The river from the dam to about 8 miles downstream is known as the Santa Ana River Canyon (referred to as the canyon reach) and is fed by several small tributaries from both sides of the river. In the canyon, the river is somewhat natural with reaches of bank stabilization. The low flow channel ranges from 100 to 400 feet wide and up to 7 feet deep and will carry about 5,000 cfs. Larger floodflows will flood across the canyon bottom with flood widths up to 1,000 feet. The average invert slope of the river is 0.003. The bed material consists mainly of medium size sands with small aprons of cobble material forming armor layers. A recent trench excavation for sewer line placement across the river exposed layers of large material beneath the surface. From a generally meandering flow path through the canyon reach, except near Featherly Park where the river is braided, the river enters a relatively straight alignment as an improved channel. The improved channel extends from just upstream of Weir Canyon Road southwesterly through an urbanized reach to the Pacific Ocean for a length of 23 miles. In the improved reach, the channel is soft-bottom with both vertical drop structures and sloping drop stabilizers. The side slopes are stone-revetted in the drop structure reach from Weir Canyon Road to the Garden Grove Freeway. There is a short subreach where the side slopes are grass-lined at the confluence with Santiago Creek. The side slopes are concrete lined downstream of Santiago Creek to the Pacific Ocean. The channel bottom width ranges from 180 to 320 feet with depths up to 18 feet. The invert slope ranges from 0.003 to 0.001 near the ocean. The natural slope along the channel alignment (without drop structures) is about 0.0025 or 13.5 feet/mile.

1-04 The bed material consists mainly of sand sizes. For most of any given year, the river is dry except for very low flows (100 to 150 cfs) that are diverted for ground water recharge in the drop structure reach.

Project Description

1-05 The proposed channel improvement from the Phase I General Design Memorandum begins immediately upstream of Weir Canyon Road and follows the existing alignment to the Pacific Ocean. There are also some minor improvements, consisting of several reaches of bank stabilization and a levee in the Santa Ana River Canyon just downstream of the Southern

Pacific Railroad crossing to protect a trailer park community. A schematic illustration of proposed channel geometry and grade is given on plate 2. In general, the proposed plan calls for: partial levee and bank improvement from Prado Dam to Weir Canyon Road (canyon reach); a soft-bottom trapezoidal channel from Weir Canyon Road to Santiago Creek confluence (drop structure reach); a trapezoidal concrete channel from about Santiago Creek to downstream of San Diego Freeway (concrete channel reach); a rectangular soft bottom channel from about the San Diego Freeway downstream from Adams Street, then transitioning to a trapezoidal soft bottom channel formed by two jetties at the ocean mouth.

Study Results for the Phase I GDM Channel Configuration

1-06 The following summary outlines the sediment transport, results for the original channel configuration shown in the Phase I GDM.

- a. Plate 11 titled "Streambed Profile at Peak of Design Hydrograph" displays the deposition slope in reaches of aggradation.
 - b. The design of levee toe depth for general scour is:

Toe Depth Minim (feet)	wm Reach (Phase(II) Stationing)
8	1204+70 - 1156+60
5	1156+60 - 535+00
6	150+50 - Ocean Outlet

- c. Plate 14 titled "Upper Sediment Level Sta 8+50 to 223+35", (Phase II Stationing) displays the allowable sediment deposition. Average annual deposition is estimated at 31,000 cubic yards per year. Frequency of cleanout is once every 20 years. No maintenance is expected in the upper portion of the concrete channel and drop structure reach.
- d. Sand outflow over project life is estimated at 36,000 cubic yards per year.
- e. Concrete channel is appropriate between station 535+00 to 150+50.
 - f. The number of drop structures and stabilizers are adequate.

2. DATA COLLECTION

General

2-01 An extensive data collection effort was conducted to obtain existing data relevant to the evaluation of sediment transport for the Lower Santa Ana River. A summary of existing data is presented in this section.

Aerial Photography

2-02 Aerial photos of the river from the Pacific Ocean to Prado Dam were taken in 1982, 1974, and as far back as 1938. Behavior of the river was particularly evident from the 1938 photos, which was photographed shortly after the flood of March 2. The aerial photos reveal a meandering tendency in the confined canyon reach changing downstream to a braided or sheetflow condition in the flat flood plain (outside of the levees).

2-03 In addition, the photos reveal reaches of significant bank erosion. These observations would aid in the development of bank erosion estimates in the canyon reach.

Geometric Data

EXISTING CONDITIONS

2-04 The existing Santa Ana River channel has undergone numerous channel improvements as a result of the damaging floods of 1938, and more recently after the floods of 1969, 1978, 1980, and 1983. The data available for the study in the improved reach consists of as-built channel plans and cross-sectional surveys. Survey data was obtained for the years 1977 to 1983. Geometric data for the canyon reach was obtained from topographic maps (scale 1" = 200', 4' contour interval) prepared by E.L. Pearson and Association for the Orange County Flood Control District (currently known as OCEMA). Examination of the data revealed that there was sufficient data to calibrate the HEC-6 model to the 1978 flood event. For verification of the model, the verification

could only be conducted in the improved reach (downstream of Weir Canyon Road) for the 1980 flood event due to the absence of sufficient survey data and some man-made changes in the canyon reach.

2-05 Project conditions cross-sectional data were obtained from the plan and profile sheets of the Phase I General Design Memoramdum (GDM), for the reach from Weir Canyon Road (Improved Channel Inlet) to Pacific Ocean. For the Phase II GDM, detailed discussion of the design features can be found in the Hydraulic Design, Volume 3. Although some of the Phase II channel features differ from those in the Phase I GDM, the differences are insignificant with respect to sediment transport. Thus, the study results are valid for the Phase II Design.

Hydrologic Data

HISTORICAL FLOW DATA

2-06 There are several locations on the Lower Santa Ana River in which historical streamflow data is available since construction of Prado Dam in 1941. These gauges are operated by the United States Geological Survey (USGS). Pertinent gauge data are provided in table 1.

Table 1. Stream Gauge Data.

Location	Period of Record	Peak Discharges (cfs)	Date		
Below Prado Dam	1940 to current 1930's (intermittent)	7,440 100,000*	Feb 21, 1980 Mar 2, 1938		
At Imperial Hwy At Ball Road	1973 to 1978 1976 to Current	4,000 18,500 11,070	Mar 4, 1978 Mar 1, 1983 Feb 16, 1980		
At Fifth St.	1923 to Current	20,100 16,100 17,800 19,100 46,300*	Mar 1, 1983 Mar 4, 1980 Feb 18, 1978 Feb 25, 1969 Mar 3, 1938		

^{*}Based on slope-area measurement of maximum flow.

²⁻⁰⁷ The streamflow data from these gauges were used to develop the hydrographs for the sediment transport model-calibration and verification phase of the study.

DESIGN FLOOD AND FREQUENCY FLOOD DATA

2-08 The development of the design flood hydrograph and balanced hydrographs at Imperial Highway with assigned frequencies of 10-, 25-, 50-, and 100-year along the main stem were generated from hydrologic study material that supports the Phase I GDM. Residual flood hydrographs for tributaries were also generated for the Santa Ana River Canyon and Santiago Creek. Comparison of the main stem design flood hydrograph from the Phase I GDM with the recently generated main stem hydrograph under the revised Upper Santa Ana River Dam alternative indicates differences are insignificant. Therefore, no adjustment was made to the hydrographs. Further discussion of the hydrologic data is presented in the Hydrology appendix, Volume 7 of this report and from reference 15.

Sediment Deposition and Removal

2-09 Previous investigations (ref. 15) cite deposition and removal quantities for the lower portion of Santa Ana River for the period since 1969. Sediment removal records prior to 1969 are not available; however, according to Orange County Environmental Management Agency (OCEMA), sediment deposition between the time the channel was built after 1938 to 1969 was probably insignificant due to the lack of major flows. An estimate of total sediment removal using information from OCEMA, indicates about 2.7 million cubic yards (yd³) removed between 1969 and 1983. Of that amount, about 500,000, 650,000, and 200,000 yd³ were removed after the 1969, 1980, and 1983 flood seasons, respectively. Using the 48-year period from 1938 to 1986 would indicate an average annual removal of about 55,000 yds³.

2-10 Estimates of sediment deposition during the 1969 flood season vary between 500,000 and 1 million yd 3 . During the 1983 flood, about 200,000 yd 3 of sediment were deposited. Both the 1969 and 1983 floods produced a depositional grade line of S = 0.0011 downstream of Slater Avenue bridge. No estimates were available for the 1978 or 1980 flood seasons.

Bed Material Gradation

2-11 Bed material samples were collected and analyzed at numerous locations from Prado Dam to the Pacific Ocean. The location of the samples are noted on plate 1, and the resulting sieve analysis of each sample are on file in the Los Angeles District. Riverbed samples were collected using a shovel and hand augar to a maximum depth of 2 feet below the surface. In the canyon reach, samples were taken from both the bed and bank of the low flow channel and from the bed of primary tributaries just upstream from the main stem. Occasional patches of surface armor layer, consisting of cobble sizes, were encountered on the bed. These materials were not included in the sampling since they are not representative of the underlying bed material nor the general surface conditions. In the improved channel reach from Weir Canyon Road to the Pacific Ocean the bed materials appear to be similar, except for a clay lense outcrop near Slater Avenue.

- 2-12 The results of the sieve analysis indicate that the bed, bank, and tributary materials in the canyon reach consist of less than 5 percent fines, 60 to 90 percent sands, and up to 40 percent gravels or larger. The bed materials for the improved channel reach indicate no fines, except for the clay outcrop near Slater Avenue where about 30 percent of the materials are fines. Bed materials typically consist of 90 to 100 percent sands, with up to 10 percent gravels.
- 2-13 The bed material gradation for Santiago Creek was obtained from a previous study (ref. 15). The bed material gradations for Santiago Creek were defined by distinct layering beneath the surface. A composite average of bed materials in Santiago Creek indicate about 25 percent fines, about 40 percent sands, and 35 percent gravels.
- 2-14 The grain size distribution for the canyon reach as represented in the HEC-6 model for various points along the canyon reach, was based on the nearest sample rather than the averaging of all of the samples. The model analysis was established in this manner to account for the large materials entering into the main stem from the tributaries.
- 2-15 In the improved channel reach, a representative grain size distribution was developed by overlaying the gradation curves and graphically compiling a single representative gradation curve (see pl. 3). The method was used to achieve a stable solution in the HEC-6 model and to avoid anomalies in sampling. The clay lense at Slater Avenue was not modeled because the improved channel would cover this reach with concrete. Clay material would therefore not enter into sediment transport calculations.

Sediment Data

2-16 The sediment data required for development of sediment transport relationships is available from the same gauging stations used to establish hydrologic data (see table 1). The period of record for sediment data is not as extensive as that for the water data, but data is available from recent floods of 1978 and 1980. Sediment data from the gauging stations was obtained from USGS published records (ref. 5) and from USGS in-house unpublished data. The data consisted of suspended-sediment measurements (measured load) along with the corresponding water discharge, water temperature, and particle size distribution. Additionally, the unmeasured load for a few events was estimated by the USGS using the Modified Einstein procedure to obtain the total instantaneous load. The sediment data were collected for water discharges ranging up to 7,000 cfs below Prado, 2,000 cfs at Imperial Hwy, 14,000 cfs at Ball Road, and 6,000 cfs at the Fifth Street gauge. The data from gauges below Prado Dam and at Ball Road was judged adequate to develop rating curves of water discharges versus sediment discharge. The data at Imperial Highway and Fifth Street was inadequate because of bed scouring at Fifth Street gauge during measurements invalidating the data and because the low water discharges at Imperial were useless for establishing the high flow portion of the rating curve.

3. PRELIMINARY ANALYSIS

General

3-01 The preliminary analysis was subdivided into two separate analyses: (1) a qualitative aggradation-degradation assessement of the river to assess the response to conditions imposed by the improved channel and (2) a quantitative analysis to determine equilibrium and limiting bed slopes. The preliminary analysis evaluates riverbed changes in the proposed river system. The results of the preliminary analysis are used subsequently to verify trends in the HEC-6 detailed sediment routing analysis.

Qualitative Aggradation Degradation Analysis

3-02 Trends of aggradation and degradation were qualitatively identified in the improved channel reach by applying Lane's relationship of dynamic equilibrium. The Lane relationship (ref. 1) can be written

 $q_s D_{50} \propto q S$

where:

q_s = The sediment discharge per unit width of the channel

 $D_{50} = Median sediment size$

q = Water discharge per unit width

S = Slope of the channel

3-03 In this relationship, the qualitative response of the riverbed can be evaluated for a given reach by comparing parameters with those for the reach immediately upstream. An increase in either water discharge or slope will result in an increase in the sediment transport capacity, assuming the median sediment size is constant. When sediment transport rate increases, degradation will occur and the bed slope will flatten. Conversely, a decrease in water discharge or slope will result in a decrease of the sediment transport capacity; deposition will occur and the bed slope will steepen. By comparing average values of unit water discharge (varying with channel width) and bed slope in representative

reaches of the improved channel with the representative width and slope of the supply (canyon) reach, the change in bed slope to maintain equilibrium can be qualitatively assessed. The supply reach (canyon) above the upper end of the improved channel is assumed in equilibrium. The improved channel reach was subdivided into five subreaches with the results shown in table 2. The overall response of the project indicates that the upper drop structure reach (subreaches 2 and 3) will be in an aggrading mode; reach 4, just upstream of the concrete reach, will be in a fairly stable mode; the concrete reach (reach 5) will be in a degrading mode, and the downstream reach (reach 6) will be in an aggrading mode.

Table 2. Evaluation of Qualitative Response Lower Santa Ana River Project Channel.

SUBRE (Loca		Bottom Side			Due To Due Pro- To file Width Overall					
DAM 1		Natural nyon reac	h)	0.003	200 500		/	N/D	N/D	N/D
2	1196+ (Drop	70 1023 Structur	_	0.0016- 0.0017	290 290	-	2:1	++	0 -	+ +
3	1023+ (Drop	60 708 Structur	+90 e Reach)	0.0017- 0.0022	320		2:1	0	+	+
4	708+ (Drop	90 528 Structur		0.00166- 0.0025	- 270		2:1	0	0	0
-	528+0 (Concr	0 192 ete Chann	+45 el Reach)	0.0017- 0.002	240 250		Vert	0	-	-
6		5 Pacifi nel Ocean		0,0008	200 480		Vert	+	+	+

*TREND DEFINITIONS:

- + Corresponds to increase in slope, or aggradation.
- Corresponds to decrease in slope, or degradation.
- O Corresponds to no change in slope.
- 1/L = low flows
- H = high flows
- N/D Not determined

3-04 The response of the bed slope to improved channel conditions can also be qualitatively predicted by examining historical bed trends since the two conditions generally conform to each other. Based on channel surveys and field observations of the 1980 flood, long duration flows on the order of 5,000 cfs tend to produce minimal bed changes in the upstream drop structure reach, significant degradation in the soft bottom reach downstream of Santiago Creek, and aggradation near the outlet to the ocean. Under improved channel conditions, the channel reach subject to severe degradation will be lined with concrete. The bed response in the other soft bottom reaches should be similar to that experienced in 1980 existing channel conditions.

Quantitative Analysis

3-05 The quantitative analysis consists of (1) determining the aggradation/degradation response of the channel bed using the concept of equilibrium bed slopes and (2) determining the limit of general degradation (stable slope) for reduced inflowing sediment loads. The following sections discuss the methodology and results of the quantitative analysis.

EQUILIBRIUM BED SLOPES

3-06 The concept of equilibrium bed slopes was applied to further identify trends of aggradation and degradation and to estimate the bed slope that the river would seek under project conditions. The equilibrium slope is that bed slope for which the capacity of the stream to transport sediment is just equal to the sediment supply flowing into a given reach. If the slope of the streambed is greater than the equilibrium slope, the bed will tend to degrade; conversely, if the bed slope is less than the equilibrium slope, the bed will tend to aggrade.

3-07 Equilibrium slopes were estimated for a range of discharges for improved channel conditions. Yang's Unit Stream Power equation was used to compute sediment transport capacity at representative sections in the project. The use of Yang's equation is explained in paragraphs 5-08 through 5-10. For each value of sediment supply and water discharge, the equilibrium slope was calculated using a trial procedure by which the bed slope was varied until the transport capacity was equal to the sediment supply. The inflowing load was based on the sediment discharge rating curve developed at the Ball Road gauge from observed data, translated upstream to the improved channel inlet. Translating the rating curve upstream 3 miles was judged acceptable since the bed change was stable during the period of measurement.

3-08 The results of the analysis, summarized in table 3, generally agrees with the qualitative analysis. The results indicate that the equilibrium slopes are sensitive to the water discharge and corresponding sediment inflow. This can be seen from the opposing trends of degradation and aggradation for the low and high flow conditions in reaches 2 and 5.

Table 3. Equilibrium Slopes Santa Ana River Project Channel.

REACH	STAT	TION To	Q (x1000 cfs)	DESIGN INVERT SLOPE	EQUILIBRIUM SLOPE	TREND*
						
1		eam of 5+70	-		-	-
2	1196+70	1023+60	5	0.0017	0.0014	_
		_	15	0.0017	0.0018	0
			30	0.0017 0.0017	0.0021	+
3	1023+60	708+90	5	0.0022	0.0030	+
			15	0.0022	0.0039	+
			30	0.0022	0.0049	+
4	708+90	528+00	5	0.0025	0.0022	0
			15	0.0025	0.0026	+
			30	0.0025	0.0030	+
5	528+00	192+45	5	0.0020	0.0016	_
			15	0.0020	0.0020	0
			30	0.0020	0.0023	+
6	192+45	Pacific	5	0.0008	0.0029	+
		0cean	15	0.0008	0.0035	+
			30	0.0008	0.0042	+

*TREND: + aggradation, - degradation, 0 no change

LIMITING DEGRADATION SLOPES

3-09 A bracketing approach to establish the lower limit of bed slope due to degradation was investigated for the case of reduced sediment supply from the canyon reach into the improved channel reach. The reduced supply reflects the possible condition that the canyon will be depleted of sediment during large flood events of long duration. As a result, the bed response expected in the improved channel reach would be general degradation. The depth of general degradation upstream of invert control locations such as drop structures and stabilizers can be quantified through the bed armor and stable slope concepts. Analysis revealed that degradation was not controlled by armoring, but rather by stable slope conditions. The following sections present the methodologies and results for both concepts.

Bed Armoring

3-10 The type of sediment forming the bed may limit the vertical degradation by development of an armor layer. The armor process is generally defined as the condition whereby there is sufficient quantities of coarse materials which cannot be transported by normal river discharges. As the degradation progresses, coarse size materials segregate from fine materials during transport. The armor layer develops as the fine materials are sorted and moved downstream while the coarse materials settle down into the bedsurface and accumulate. Eventually, enough coarse materials accumulate to form an armor layer over the entire bed surface. The underlying materials are trapped and vertical degradation is arrested. The bed slopes are computed by applying the depth of degradation upstream of invert control locations.

3-11 The methods used to determine the armor size, as summarized by the Bureau of Reclamation (ref. 16) and repeated herein, are:

- 1. Meyer-Peter, Muller (bedload transport equation)
- 2. Competent bottom velocity
- 3. Lane's tractive force theory
- 4. Shields diagram
- 5. Yang incipient motion

It should be noted that several of the equations apply correction factors to account for mixing of units.

Meyer-Peter, Muller (Bedload Transport Equation)

3-12 Bedload transport equations provide a method to compute a nontransportable particle size representing coarse bed material capable of forming an armoring layer. To describe a nontransportable size, the Meyer-Peter, Muller bedload equation for beginning transport of individual particle sizes was applied.

$$D_{c} = \frac{dS}{K \frac{n_{s}}{D_{90}^{1/6}}}$$
 3/2

where:

Do = Individual particle size in millimeters

K = 0.19 inch-pound units

d = Mean water depth at dominant discharge, ft

S = Slope of energy gradient, ft/ft n_s = Manning's "n" for bed of stream

D₉₀ = Particle size in millimeter at which 90 percent of bed material by weight is finer.

Competent Bottom Velocity

3-13 The competent bottom velocity method for determining armoring size is computed from a relationship between mean channel velocity with armoring size by the equation:

$$D_{c} = 1.88 \, v_{m}^{2}$$

where:

 D_c = Armor size, mm V_m = Mean channel velocity, ft/s

Lane's Tractive Force

3-14 The tractive force method relates the critical tractive force versus the mean particle size diameter in millimeters, which is reproduced in figure 1. This method entails computing the critical tractive force using the channel hydraulics for dominant discharge. By selecting an appropriate curve from figure 1, usually the recommended set of "curves for canals with clear water in coarse noncohesive material," a critical tractive force can be obtained which gives the lower size limit of the nontransportable material $D_{\rm c}$.

where:

T_c = Critical tractive force, lb/ft²

Sw = Specific weight) (mass) of water, 62.4 lb/ft³

d = Mean water depth, ft

S = Slope, ft/ft

Shields Diagram

3-15 Many investigators use the Shields diagram figure 2, to define the initiation of motion for various particle sizes. In the process of armoring of a streambed for predominantly gravel size material greater than 1.0 mm and high Reynold's number R* greater than 500, the Shields parameter given below provides a method for determining an armor size.

$$T_{\pi} = \frac{T_{c}}{(\gamma_{s} - \gamma_{w})D_{c}} = 0.06$$

where:

 T_* = Dimensionless shear stress T_c = Critical shear stress = $_{\rm w}$ dS, lb/ft² /s = Specific weight (mass) of the particle, 165 lb/ft³ /6 = Specific weight (mass) of water, 62.4 lbs/ft³ D_c = Diameter of particle, ft

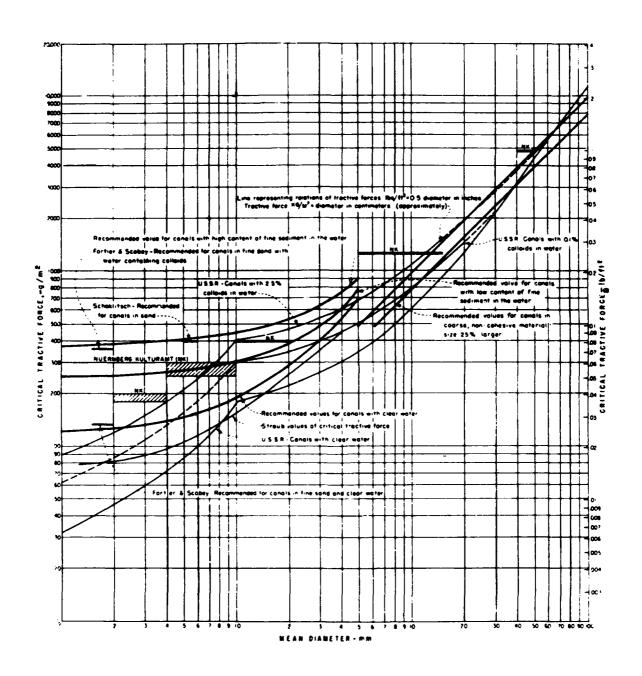
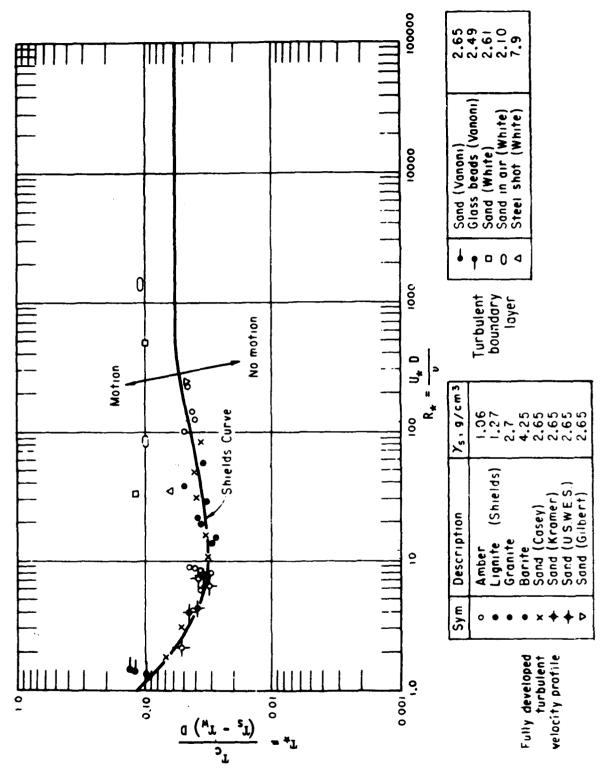


Figure 1. Tractive Force vs. Tranportable Sediment Size (reprinted from ref. 16).



1

Shields diagram for initiation of bed material movement (reprinted from ref. 16). Figure 2.

Inch-pound units

w = 62.4 lb/ft³
s = 165 lb/ft³
d = Depth, ft
S = Slope, ft/ft
D_c = Size, ft

Yang Incipient Motion

3-16 Yang relates the dimensionless critical velocity, $V_{\rm cr}/w$, and shear velocity Reynold's number, $R_{\rm H}$, at incipient motion. Under rough regime conditions where $R_{\rm H}$ is greater than 70, the equation for incipient motion is:

$$\frac{v_{cr}}{w} = 2.05$$

The settling velocity for material larger than 2 mm in diameter will approximate the fall velocity by:

$$w = 6.01 D_c^{1/2}$$

These equations can be combined to give:

$$D_{c} = 0.00659 \, V_{cr}^{2}$$

where:

 $V_{\rm cr}$ = Critical average water velocity at incipient motion, ft/s w = Terminal fall velocity, ft/s $D_{\rm c}$ = Size, ft

3-17 The above equations were applied using hydraulic computations for design discharges in the drop structure reach. Table 4 summarizes the results of the computations. The results indicate that degradation would not be limited by armoring because the minimum armor particle size (10 mm) is not available in sufficient quantities in the bed material, since the d_{95} of the bed material is 2 mm. The method of stable slope was then applied to determine the limiting degradation slope.

Table 4. Bed Armor Size.

	Method	Particle Size (mm)		
1.	Meyer-Peter Muller	10		
2.	Competent bottom velocity	65		
3.	Lane's tractive force theory	23		
4.	Shield's diagram	20		
5.	Yang incipient motion	70		

Stable Slope

3-18 In cases where the general degradation is not limited by the armoring process, the concept of stable slope can be applied. The stable slope method for computing degradation is based on degradation processes occurring until a slope is reached which results in negligible bedload transport. The stable slope is determined by applying several relationship for bed movement (ref. 16).

- Schoklitsch bedload equation.
- 2. Meyer-Peter, Muller bedload equation.
- 3. Shields diagram for no motion.
- 4. Lane's relationship for critical tractive force.

The methods are described as follows:

Schoklitsch Method

3-19 The Schoklitsch equation for zero bedload transport is expressed as follows:

$$S_L = K \left(\frac{DB}{Q}\right)^{3/4}$$

where:

 S_1 = Stable slope, ft/ft K = 0.00174 inch-pound units

D = Mean particle size, mm

B = Channel width, ft

 $Q = Dominant discharge, ft^3/s$

Meyer-Peter, Muller Method

3-20 Limiting slope computations by the Meyer-Peter, Muller beginning transport equation are:

$$S_{L} = \frac{\left(\kappa \frac{Q}{Q_{B}}\right) \left(\frac{n_{s}}{D_{90} 1/6}\right)^{3/2} D}{1/6}$$

where:

 $S_L = Stable slope, ft/ft$ K = 0.19 inch-pound units

= 0.19 inch-pound units = Ratio of total flow in ft³/s to flow over bed of stream (ft³/s). Usually defined at dominant discharge where $\frac{Q}{Q_R} = 1$ for wide channels

 D_{QQ} = Particle size at which 90 percent of bed material by weight is finer

n_s = Manning's "n" for bed of stream
D = Mean particle size

d = Mean depth, ft

Shields Diagram Method

3-21 The use of Shields diagram for computing a stable slope involves the relationship of the boundary Reynold's number R# varying with the dimensionless shear stress T_{*} shown in figure 5 as follows:

$$R_{\#} = \frac{U_{\#} D}{T_{\pi}}$$

where:

R_# = Boundary Reynold's number

 $U_{\#}$ = Shear velocity $S_L R_g$, ft/s

S_L = Slope, ft/ft
R = Hydraulic radius or mean depth for wide channels

g = Acceleration due to gravity, 32.2 ft/s

D = Particle diameter, ft

 \mathbf{v} = Kinematic viscosity of water varying with temperature, ft²/s

and

$$T_{*} = \frac{Tc}{(\delta s - \delta w) D}$$
 (16)

where:

 $T_{\#}$ = Dimensionless shear stress

c = Critical shear stress lb/ft² equal to wdSL

is = Specific weight (mass) of particles, 165.4 lb/ft3 (2.65 t/m^3)

 $\mathbf{fw} = \text{Specific weight (mass)}, 62.4 \text{ lb/ft}^3$

d = Mean depth, ft

S_L = Slope, ft/ft
D = Particle diameter, ft

Lane's Tractive Force Method

3-22 Critical tractive force is defined as the drag or shear acting on the wetted area of the channel bed and is expressed as:

$$Tc = \Upsilon_{w} dS_{L}$$
 (17)

rewriting in terms of S_T

$$S_{L} = \Upsilon_{C} / \delta w^{d}$$
 (18)

where:

 T_c = Critical tractive force, lb/ft^2 (may be read from the curve in figure 1. Enter the abscissa scale with the D_{50} or D_m in millimeters and read the critical tractive force value from the curves for canals with glear water).

∛w = Specific weight (mass) of water, lb/ft³

d = Mean water depth for dominant discharge, ft

3-25 Generally, the method of stable slope would be applied to the dominant discharge. However, to determine the maximum potential for degradation, the method was applied using hydraulic computations for the design discharge. Table 5 summarizes the results of the computations.

Table 5. Stable Slope.

	Method	Slope	
(1)	Schoklitsch	0.000029	
(2)	Meyer-Peter, Muller	0.000029	
(3)	Shield	0.0000073	
(4)	Lane	0.000004	

3-26 By applying the mildest of these slopes to reaches upstream of invert control points, it was found that general degradation would be no greater than 5 feet below the design invert.

4. SEDIMENT INFLOW

General

4-01 Sediment inflow into the improved channel reach was estimated for the design flood and on an average annual basis. The objective was to determine the bed response and annual maintenance in the improved channel reach. The sources of sediment are from the Santa Ana River Canyon and from Santiago Creek. Other tributaries in the main project reach drain urbanized area and therefore contribute clearwater flow as a result. Design flood and long-term sediment inflow from the canyon reach was estimated with methodologies described in subsequent sections.

4-02 Santiago Creek sediment inflow was developed using the Yang Unit Stream Power sediment transport equation. The total sediment inflow into the improved channel reach consisted of the supply from the canyon reach at Weir Canyon Road and the supply from Santiago Creek at the confluence with the Santa Ana River. The two sediment inflow points were applied in the HEC-6 detailed routing analysis for the design flood to determine the bed response in the improved channel reach. For the long term sediment inflow, only the canyon was considered as the sediment contributor in the HEC-6 analysis since low flows under long term conditions in Santiago Creek will not contribute a significant quantity of sediment.

Design Flood

GENERAL.

4-03 The quantification of the sediment supply for the design flood involves considering the sources of sediment from the Santa Ana River canyon and Santiago Creek. In the canyon reach, the analysis addresses sediment contributions from the riverbed, the banks, the tributaries entering into the canyon, and the outflow from Prado Dam. To account for the net effect of these sources, a rating curve of water discharge versus sediment discharge was developed at the downstream end of the

canyon using two methods. First, a sediment discharge rating curve was established based on actual sediment load measurements from stream gauges located at Ball Road and downstream of Prado Dam. Second, the Corps of Engineers' HEC-6 sediment computer program was utilized to route sediment in the canyon reach during the design flood including sediment contributions from both tributaries and bank erosion. A comparison of the two sediment discharge rating curves revealed that the curves were fairly close. As a result, the rating curve developed from the HEC-6 canyon analysis was selected for the design flood analysis into the improved channel reach. The HEC-6 rating curve was considered to be the maximum sediment load available into the improved channel reach during the design flood event. The analysis and results of both methods are presented in the subsequent paragraphs.

STREAM GAUGE WATER SEDIMENT DISCHARGE RATING CURVES

4-04 As discussed previously in paragraph 2-07, there is sufficient data to establish water-sediment rating curves for the stream gauges located below Prado Dam and at Ball Road. To account for the total sand discharge, the suspended load measurements were adjusted to exclude the wash load (i.e., material finer than 0.062 mm) and to include the unmeasured load (bed load). The unmeasured load was estimated by the Modified Einstein Procedure or the Colby Method (ref. 4). The Colby Method was used where the USGS did not estimate the unmeasured load with the Modified Einstein Procedure. The water sediment discharge ratings were developed in the following form:

$$Q_{s} = aQ_{w}^{b}$$

where $\mathbf{Q_S}$ is the sediment transport load in tons per day, $\mathbf{Q_W}$ water discharge in cfs, and a and b are the best-fit coefficient and exponent from regression analysis of water sediment discharge data.

The resulting relationships are:

$$Q_{s} = 0.003 Q_{w}^{1.42}$$
 below Prado Dam
 $Q_{s} = 0.181 Q_{w}^{1.564}$ at Ball Road

4-05 These relationships were based on flow measurements up to 7,000 cfs below Prado Dam and 14,000 cfs at Ball Road. To account for the sediment discharge at the design discharge, straight-lined extrapolation of these relationships on a log-log scale was considered to be reasonable and was used to give insight on the potential for sediment inflow. The translation of the Ball Road rating curve to the project inlet was judged applicable since the channel between these locations has remained fairly stable during the period of record. It should be noted that data from the Fifth Street gauge was unreliable due to the invalidation of the rating curve as a result of scouring of the bed during the 1980 flood event.

HEC-6 CANYON ANALYSIS

4-06 Sediment transport in the Santa Ana River Canyon was simulated using the HEC-6 sediment program for the design flood event. The HEC-6 analysis included the additional sources of sediment from tributaries and from bank erosion. Tatum's method was applied to estimate tributary sediment inflow and aerial photos along with topographic maps were used to identify areas of potential bank erosion. The HEC-6 method was of significant value since it provided a reasonable estimate of the maximum potential for sediment inflow from the canyon reach for flows in excess of actual measured flows, that is, for flows from 14,000 cfs to the design peas of 38,000 cfs. The resulting outflow of sediment from the canyon reach represents the net effect from all possible sources of materials. The results of the HEC-6 analysis were translated into water-sediment discharge rating curves (see pl. 6) to be used for input data in the HEC-6 analysis for the proposed downstream project (improved channel reach). The rating curves represents the relationship between water and the bed-material load. It was assumed that the wash load, as defined previously, would be transported throughout the improved channel without deposition. The rating curves presented on plate 6 are the sediment load discharges during the rising side and the recession side of the design flood hydrograph. The difference in the rating curves reflects the depletion of available sediment into the project. The analysis and the results of the application of Tatum's method and the bank erosion are presented in the subsequent paragraphs.

Tatum's Method

4-07 Tatum's method (ref. 23), was applied to the Santa Ana River Canyon watershed to estimate the sediment volume that could occur during design flood event. The use of Tatum's method was deemed applicable because it would be applied to tributary watersheds similar to watersheds in Los Angeles County from which the data was drawn. The factors that influence debris production are:

- 1. Drainage area
- 2. Average slope of the longest water course from the uppermost representative elevation to the downstream concentration point.
- 3. Drainage density or ratio of total stream length.
- 4. Hypsometric index or relative elevation at which the drainage area is divided into two equal parts.
- 5. Three-hour rainfall.
- 6. Burn effect.

4-08 This method involves estimation of the total debris production for a one square mile area and adjustment of that value to account for the above six factors. Factors relating to the topography of the study watershed were obtained from USGS Quadrangle maps. Plate 4 defines the tributary boundaries. The 3-hour rainfall values were used for the 3-hour SPF local thunderstorm, which represents a worse case scenario for sediment inflow into the main stem. Table 6 lists the tributaries and the results of the Tatum calculations. The debris productions rates shown represent ground conditions 4 to 5 years after 100 percent burn.

The rates were judged reasonable for use as tributary sediment inflow during the design flood. The tributary sediment was input into the program during the rising side of the design hydrograph and consisted of sand sizes.

Santa Ana River Canyon Bank Erosion

4-09 A one-dimensional program such as HEC-6 for sediment transport modeling is limited to estimating the vertical aggradation/degradation trends in a river. The lateral component of bank erosion cannot be calculated in most sediment transport programs due to problems associated with the prediction of bank erosion. Thus, in order to account for the sediment contribution from bank erosion from the low flow bank line to the edge of bank stabilization or canyon sides, an estimate of the gross volume of eroded sediment was made. This data was then input into the program as a constant rate of sediment inflow consisting of sand sizes for the entire period of the design flood hydrograph.

Table 6. Results of Tatum Calculations for Tributary Sediment Inflow.

Tributary	Drainage Area (mi ²)	Debris Production (yd ³) x 1000	
A. Blue Mud	4.44	219	
В. *	0.60	46	
C. Box Cyn	0.65	65	
D. Bee Cyn	1.32	89	
E. *	0.56	55	
F. Brush Cyn	1.52	82	
G. Aliso	10.47	291	
н. *	0.73	56	
I. Walnut	2.36	95	
J. *	0.52	46	
K. *	1.12	60	
L. Weir	2.00	35	
M. Gypsum	5.17	204	
N. Coal	2.03	265	
0. *	0.65	122	
P. Fresno	.170	189	
Q. Wardlow Wash	5.71	83	
Total	41.55	2,002,000 yd ³	

*Unnamed Tributaries.

4-10 Basically, banks that are unprotected by revetment and located on curves, that is, banks subject to impinging flood flows, were identified as potential areas for erosion. The limits of bank erosion were estimated primarily by engineering judgement using 1938 aerial photos, observations of erosion caused by recent floods, HEC-2 overflow analysis, and (1982) topographical maps, see plate 5. The volume of sediment was computed as the plan view area of erosion multiplied by the height of the bank. Table 7 presents the results of the analysis. This estimate applies only to the design flood event.

Table 7. Results of Bank Erosion for Design Flood.

Location on Plate 5	Plan View Area Eroded (ft ² x 1000)	Height of bank (ft)	Volume of Eroded Bank (yd ³ x 1000)
E1	245	10	90
E2	1,110	11	448
E3	245	13	118
E4	1,820	8	540
E 5	555	9	185
E 6	190	8	56
E7	1,213	11	494
E8	220	13	106

Total = $2.037.000 \text{ yd}^3$

SANTIAGO CREEK-DESIGN FLOOD SEDIMENT TRANSPORT

4-11 Santiago Creek is the only other possible source of sediment to the main stem of the lower Santa Ana River. The total drainage area is 102 square miles. The available bed material load to the Santa Ana River, however, would be severely reduced by the construction of the Santiago Creek Project and the existing gravel pits and reservoirs located on the creek. The drainage area is comprised of: Santiago Reservoir (Drainage Area (D.A.) = 63 square miles), located 13 miles upstream from the confluence; Villa Park Dam (Incremental D.A. below Santiago Reservoir = 20 sq. mi.), located 10 miles upstream of the confluence; and gravel pits (Incremental D.A. below Villa Park Dam = 9.1 sq. mi.), located 7 miles upstream of the confluence. The incremental drainage area downstream of the gravel pits, consisting of urbanized development, is 8.1 square miles. In general, the Santiago Creek Project would consist of enlarging the existing gravel pits and channel stabilization of the lower 6,000 feet of channel immediately upstream from the confluence with the LSAR. The gravel pits would serve as a

regulating reservoir, but would also be a sediment trap for the inflowing bed-material load. The channel improvements downstream of the gravel pits would be designed to prevent erosion. The combined improvements would result in a negligible quantity of sediment load into the LSAR.

4-12 For design flood conditions, a worse case scenario for sediment inflow into the improved channel was developed to include both the Santa Ana River Canyon and Santiago Creek. The analysis objective was to ensure that the project would function under these heavy load conditions. To estimate the sediment inflow from Santiago Creek, a simplified procedure utilizing a sediment discharge rating curve was employed. The rating curve was established using the Yang Unit Stream Power transport function. The necessary hydraulic data was generated from normal depth computations for a representative reach in Santiago Creek. The resulting rating curve was then applied to the coincident design flood hydrograph.

Sediment Yield

4-13 Sediment yield was estimated in the Santa Ana River Caryon to verify the average annual sediment outflow to the Pacific Ocean and the deposition within the channel, both of which were computed on an event basis. The analytical methods presented for determining sediment yield were developed from watersheds in the southwestern United States. Estimates of sediment yield (long term supply of sediment) were made by applying the Pacific Southwest Interagency Committee (PSIAC) method, Flaxman's method, and from sediment depositional data from a nearby Santiago reservoir. The sediment yield estimates developed from the PSIAC and Flaxman methods would then be verified with actual sediment yield measurement from Santiago reservoir.

Pacific Southwest Interagency Committee Method

4-14 The Pacific Southwest Interagency Committee (ref. 22) has developed a method of rating sediment yield from a watershed for use as an aid for broad planning purposes only. The method consists of numerically rating nine factors that influence sediment production in the watershed and then summing up the ratings. This final rating corresponds to a range of sediment yields in acre-feet per square mile. The ranges of estimated yield values indicate that precision is not the intended result of the PSIAC method.

4-15 The PSIAC Committee has tested their method against actual sediment-yield values measured in ponds and dams in the southwest. The comparisons were made on watersheds with drainage areas less than about 20 square miles. The PSIAC results either agreed with or were slightly lower than the actual measurements.

4-16 The nine factors that are rated in the PSIAC method are surface geology, soil, climate, runoff, topography, ground cover, land use, upland erosion, and channel erosion/sediment transport. These factors

were rated for the contributing watershed on the basis of data obtained from aerial photography, topographic maps, Soil Conservation Service soil maps, and on site observation. The nine factors were applied to obtain an average annual yield of 1.64 acre-feet per square mile per year.

Flaxman Method

4-17 A relationship for predicting sediment yield in the western United States was developed by Flaxman (refs. 18, 19 and 20). The equation relates sediment yield to climate, topography, hydrology, and two soil characteristics i.e., percent particles coarser than 1 mm and aggradation or dispersion characteristics of clay size particles. Several forms of the equation exist but the form used in this study is from a paper by Flaxman (ref. 20):

$$y^{0.5} = -86.07 - 5.30 (x_1)^{0.5} + 7.33 (x_2)^{0.5} - 1.63 (x_3)^{0.5}$$
$$+ 10.79 (x_4)^{0.5} + 0.92 (x_5)^{0.5}$$

where:

y = Sediment yield in tons per square mile;

- x₁ is the ratio, in percent, of the average annual precipitation in inches to the average annual temperature in degrees F, quantity divided by 1.43;
- x_2 is the average slope of the watershed in percent;
- is the percentage of particles coarser than 1.0 mm in the surface 2 inches of soil, divided by 72;
- x_{ij} is the percent of clay in the surface 2 inches of soil plus 100 if the pH of the soil is greater than seven, 100 minus the percent of clay if the pH of the soil is equal to or less than seven; and
- x₅ is the 2-year flood discharge in cubic feet per second per square mile (csm).

4-18 A special note should be made here that the units for Y do not work out if a rigid unit analysis is made considering variable units only. As discussed in the 1982 San Diego Sediment Seminar, the coefficients include conversion factors that adjust the input data such that Y is in terms of tons per square mile. The theory used in employing the above variables is as follows:

 χ_1 : The precipitation to temperature (P/T) ratio is intended as an indirect expression of the natural response of vegetation to climate. It was assumed that the higher the P/T ratio, the better the vegetative cover, except when the watershed is disturbed. The divisor of 1.43 represents the best cover as indicated by the highest P/T ratio.

- X_2 : Almost all efforts at predicting erosion and sediment yield have used slope as an influencing factor.
- X₃: The purpose of using soil particles coarser than 1 mm was to determine the effect of desert pavement on erosion and yield. The divisor, 72, is the highest percentage of rock fragments in the population.
- χ_{μ} : This factor is intended to be an indicator of the aggregation or dispersion characteristics of the soil, with an alkaline reaction assumed to symbolize dispersion, an acid reaction, aggregation.
- x_5 : The 2-year flood peak discharge, cubic feet per second per square mile is assumed to resemble average annual maximum climatic stress on a watershed.
- 4-19 Pertinent data and results of the analysis are presented in table 8. Average annual yield ranges from 49 to 1,156 ton per square mile per year (0.02 0.59 acre-feet per square mile per year).

Measured Data

4-20 Sediment yield data was available from Santiago Reservoir, which is located in the Santa Ana mountains about 6.5 miles south of the Santa Ana River Canyon. The data indicated a yield rate of about 1.45 acre-ft/mi²/year for a 16.8 year period of record starting December 1931 through September 1948.

Selected Sediment Yield Rate

4-21 Results of sediment yield analysis indicate that the yield rate from the PSIAC method is reasonable for the area based on comparison to sediment data on Santiago Reservoir. The yield rate from the Flaxman method was unreasonably low. Therefore, the PSIAC method was selected for this study. Applying the PSIAC yield rate of 1.64 AF/mi²/year to the contributing drainage area of the canyon of about 42 to 50 mi² would yield 68.8 to 82 AF/year. Converting units to cubic yards would yield 108,000 to 132,000 yds/year. By applying a ratio that 40 percent of the sediment yield is comprised of sand, which was presented by Brownlie et. al. (ref 7), the sand sediment yield range would be 43,200 to 52,800 cubic yards per year. These figures would later be used for comparison with the average annual sand outlfow and the channel deposition computed using the incremental probability method.

Other Tributaries

4-22 Other tributaries in the improved channel reach are the Greenville-Banning and the Carbon Canyon Diversion channels, which enter into the Santa Ana River at river mile 1.3 and 15.9, respectively, upstream from the river mouth.

Table 8. Flaxman's Method For Sediment Yield.

VAR	ABLE		Х1	XŽ	Х3	χ4	Х5		
Sub area	D.A mi ²	Precip (P) in	P/T ¹ / T=63 ^o F (\$)	Slope	Soil 1mm %	Clay %	2 yr Flood (cfs/sq mi)	•5 Y	Yield Tons (mi ²)
A	4.44	12.0	.19 (13)	6	.26	86	11	15	225
В	0.60	12.2	.19 (13)	7	.26	86	17	17	289
С	0.65	12.0	.19 (13)	9	.26	86	18	20	400
D	1.32	12.0	. 19	7	.26	86	12	17	289
E	0.56	12.0	.19	10	.26	86	18	21	441
F	1.52	12.0	.19	5	.26	86	13	14	196
G	10.47	12.0	. 19	2	.26	86	7	7	49
Н	0.73	13.0	.21	7	.26	86	15	17	289
I	2.36	12.0	. 19	4	.29	85	13	11	121
J	0.52	12.0	.19	7	.29	85	19	17	289
ĸ	1.12	12.0	. 19	5	.29	85 .	14	13	169
L	2.00	12.0	.19	6	.29	85	14	15	225
M	5.17	13.0	.21	6	.29	85	11	13	169
N	2.03	13.0	.21	15	.29	85	13	25	625
0	0.65	13.0	.21	25	.29	85	20	34	1156
P	1.70	13.0	.21	16	.29	85	13	26	676
Q	5.71	13.0	.21	7	.29	85	11	16	256

Avg temp = 63°F @ 710' MSL (1974 SAR Survey Report)

Avg precip from Santa Ana River Survey Report 1974, Plate 3, "Mean Seasonal Precipitation".

4-23 The drainage area on Greenville-Banning is 10.4 square miles. Bed-material load to the Santa Ana River is judged insignificant because the tributary drains urbanized area and therefore clearwater flow. In addition, the magnitude of coincident tributary flow of 1,000 cfs is small as compared to the design flow of 46,000 cfs on the main stem.

4-24 The total drainage area for Carbon Canyon Diversion Channel is 34.2 square miles. The drainage area is comprised of: Carbon Canyon Dam (drainage area = 19.3 sq. mi.), located 5.0 miles upstream from the confluence; and the Miller Stilling Basin (incremental drainage area below the dam of 14.9 sq. mi.), located 1.5 miles upstream from the confluence. There is no significant incremental drainage area downstream of the basin. Bed-material load to the Santa Ana River is also judged insignificant because of the dam and basin cutting off sediment to the downstream channel. The coincident tributary flow of 2,000 cfs is small as compared to the design flow of 38,000 cfs on the main stem.

4-25 This sediment study, therefore, does not include any sediment inflow from the aforementioned tributaries for the design flood and for the smaller floods on the Santa Ana River.

5. SEDIMENT TRANSPORT ANALYSIS IN THE IMPROVED CHANNEL REACH

General Approach

5-01 The sediment transport in the improved channel reach was simulated using both the Corps of Engineers' Hydrologic Engineering Center sediment transport computer program HEC-6 and a HEC-6 modified version H6NBS36 developed by Waterways Experiment Station. Sediment transport in the project was simulated for the design flood and for the 10-, 25-, 50-, and 100-year floods under with project conditions. The computer simulation with HEC-6 involved a detailed process summarized as follows:

- 1. Preparation and input of geometric, sediment and hydrologic data for the program.
- 2. Calibration and verification of the various hydraulic and sediment program parameters from known prototype events.
- Execution of the program under project conditions for various floods of interest.
- 4. Analysis of degradation and aggradation trends and recommendations for design water surface profile computations.
- 5. Sensitivity analysis of the various program parameters and of various design conditions.

The improved channel reach analyzed with the HEC-6 program extended from the inlet at Weir Canyon Road downstream to the Pacific Ocean.

Calibration of the Program Data

5-02 The calibration process is the initial step in the development of the HEC-6 model for latter use in bed response prediction under improved channel conditions. Calibration of the HEC-6 model involves adjusting and selecting various hydraulic and sediment parameters in the model in

order to reproduce known historical bed aggradation and degradation trends in the river over a given period of time. The calibrated model will then serve as a basis for trial against a second set of conditions associated with a flood event to test the model for bed change prediction. This second procedure is referred as the verification of the model. Once the model has been calibrated and verified to reconstitute historical events reasonably, then the model can be used to predict bed changes of different flood events with confidence.

5-03 The geometric data set selected for calibrating the model was the flood of 1978. Sufficient cross-sectional survey data were available before and after the 1978 flood to determine the resulting bed changes for the river reach from Prado Dam to the Pacific Ocean with the exception of the reach near the confluence with Santiago Creek. To be consistent with the model geometric adjustment, which uses a uniform bed elevation change across the cross-section, the average 1978 vertical bed change in each cross section was determined graphically from the survey data plots. Plate 7 presents the before and after 1978 flood invert bed profile. Hydrologic data was obtained from the USGS for the stream gauges located on the Lower Santa Ana River, as discussed in paragraph 2-06. The various parameters in the calibration process which were considered are:

- a. the sediment transport function
- b. the bed material gradation
- c. the sediment inflow load
- d. the percent of the moveable bed surface between cross sections
- e. the Manning's "n" values

5-04 Although setting one of the above parameters may influence another parameter, the most important parameter is the sediment transport function, which is discussed later in paragraphs 5-08 to 5-10. The bed material gradation used in this HEC-6 calibration analysis is shown on plate 3. The sediment inflowing load was zero since the model would begin just downstream of Prado Dam. The data from the stream gauge below Prado Dam indicated virtually zero bed material load passing through the dam. The limits of the movable bed widths were established considering the flow conditions and hardpoints such as revetted banks.

5-05 The actual calibration was performed by setting "n" values based on current field conditions and executing each of the four transport functions available on HEC-6. The Yang transport function was selected (see paragraphs 5-08 through 5-10) and used in all the subsequent analysis with HEC-6 because the Yang function reconstituted the actual changes closer than the other functions. The "n" values were adjusted until a close agreement was accomplished with the observed bed changes. The results of the HEC-6 calibration process are shown on plate 7. It was concluded that the HEC-6 model was calibrated and that it would be reasonable to proceed to the verification procedure.

Verification

5-06 The verification of the calibrated HEC-6 model entails executing the model against an entirely different flood event from which the model was calibrated. The model is said to be verified when it reconstitutes the observed river bed changes. To verify the model, the 1980 flood was selected since there was adequate channel survey and hydrologic data from which to determine the river bed changes and the corresponding flood discharges. The Santa Ana River Canyon reach, however, was the only reach where survey data was unreliable due to numerous man-made changes. Consequently, the verification process was conducted for the reach downstream of Weir Canyon Road, which is at the downstream end of the canyon. To account for the sediment inflow from the canyon reach, a sediment-discharge rating curve was instituted using the sedimentdischarge curve developed at the Ball Road stream gage (see paragraph 4-04 to 4-05. Translating the curve upstream to Weir Canyon Road, which is the project channel inlet location, was judged reasonable, since the channel between these two locations experienced insignificant bed change during the 1980 flood.

5-07 The results of the verification run using Yang's transport function indicate that the model agrees fairly well with the actual bed changes, except for the channel reach extending from confluence with Santiago Creek to the San Diego Freeway. In this reach, the model underestimated the degradation of the channel. To reconstitute the degradation quantities, the model was adjusted (calibrated) on a preliminary basis by inputting a finer bed material gradation to simulate the fine material existing in the channel, (see paragraph 2-11). The adjusted model did reproduce the degradation in this reach. However, the adjustment was judged to be unnecessary because the project calls for lining the channel with concrete in this reach, thus preventing erosion. The bed material gradation in the model should rather represent the material entering into the concrete reach. Therefore, the model was considered to be verified without the preliminary bed material adjustment. Plate 8 displays the before and after 1980 invert bed profile and the results of the HEC-6 verification simulation.

Sediment Transport Function

5-08 The HEC-6 program contains four different sediment transport functions for computing the sediment transport in the river. The four options are: (1) Toffaleti's method, (2) Madden's modification of Lursen's relationship, (3) Yang's Unit Stream Power method, and (4) DuBoy's method.

5-09 The selection of the appropriate sediment transport function was based on two approaches. First, each function in HEC-6 was tested against the historical bed changes in the calibration process assuming the same basis of "n" values, sediment inflowing load, and bed-material gradation. Application of the Toffaleti and the DuBoy's methods in the

program produced changes in bed elevation that were much less than and much greater than the historical, respectively. Attempts were made to use the Laursen method, but internal problems with the program code caused this method to be excluded from the calibration process. Lastly, the Yang function was tested and resulted in predicted bed changes that were in close agreement with the historical.

5-10 Second, the functions were tested against the measured load at the Ball Road stream gage by using the program to compute the sediment load with each function. In addition, the Ackers-White equation was computed manually for comparison with the measured load for possible application in the program if the other functions proved to be unsuccessful. The results of the computed load versus measured load are shown on plate 9. The results indicate that for the measured flow range of 1,000 to about 7,000 cfs, the Duboy and Yang function were fairly close to the measured load. The Ackers-White equation produced lower sediment discharge values than the Yang function and was dropped from further analysis. Additionally, the Yang function proved to be the most successful in calibrating against historical bed changes and was within an acceptable range with the measured load. As a result of this analysis, the Yang Unit Stream Power equation was selected for estimating the bed-material load in the river. The Yang equation (ref. 10) used in this study is:

$$\log C_{t} = 5.435 - 0.286 \log \frac{\text{wd}}{\text{v}} - 0.457 \log \frac{\text{U*}}{\text{w}} + (1.799 - 0409 \log \frac{\text{wd}}{\text{v}} - 0.314 \log \frac{\text{U*}}{\text{w}}) \log (\frac{\text{VS}}{\text{W}} - \frac{\text{VerS}}{\text{W}})$$

where:

= Total sediment concentration, in parts per

million by weight,

= Terminal fall velocity of sediment particles, ft/sec

= Median sieve diameter of bed material, ft

= Kinematic viscosity, ft²/sec

= Shear velocity, ft/sec

= Unity stream power, ft/sec. ft/ft

VorS = Critical unit stream power at incipient motion, ft/sec

HEC-6 Input Data

CHANNEL GEOMETRY

5-11 The channel geometry under project conditions was obtained from plan and profiles sheets in the Phase I GDM. Cross sections were encoded into the HEC-6 model beginning at the project inlet at Weir Canyon Road downstream to the Pacific Ocean. Spacing of the cross sections ranged from 100 to 1,500 feet apart with an average of about 1,000 feet. Cross sections were also located at control invert points in the river such as drop structures and stabilizers.

BED MATERIAL GRADATION

5-12 The representative bed material gradation, as discussed previously in paragraph 2-15, was used in the HEC-6 project analysis for all the various floods, (10-, 25-, 50-, 100-year) including the design flood. The program requires a gradation with each cross section defined in the geometry data set. In order for the HEC-6 to represent the concrete-lined channel and invert hardpoints such as drop structures and stabilizers, the model was encoded with a bed material layer of 0.1 feet to exist on the design invert. The 0.1 feet thick of bed material allows the program to execute in a deposition potential mode only. Scour of the bed will not occur in the concrete reach or at channel invert hardpoints.

HYDROLOGIC DATA

5-13 Several different flood events were investigated with the HEC-6 program to evaluate the adequacy of the project design with respect to sediment transport. The floods analyzed were the project design flood (170-year) and the 10-, 25-, 50-, and 100-year flood frequency events.

5-14 The hydrologic analysis for the Santa Ana River was conducted with the Corps of Engineers' Los Angeles District Flood Hydrograph Package (LADFHP). Flood hydrographs for the design flood were provided along the project reach that included residual flow from tributaries in the Santa Ana River Canyon and Santiago Creek. For all floods, balanced hydrographs were developed based on with project condition and based on both peak and volume frequency analysis from regulated releases out of Prado Dam. For these floods, tributary inflow was neglected since there are numerous coincident flow combinations between the main stem and each tributary. To account for the inflow of sediment from tributaries in the canyon reach, a sediment discharge rating curve was used at the project inlet at Weir Canyon Road. For Santiago Creek, inflow of sediment would be negligible with construction of a stable channel. Plate 10 displays the balanced hydrographs. It should be noted that trib tary inflow from Greenville-Banning Channel and Carbon Canyon Dive. sion Channel would not impact on transport of sediment since the inflow discharges are small relative to discharges on the main stem.

IMPROVED CHANNEL HYDRAULIC ROUGHNESS

5-15 Hydraulic roughness is accounted for in the HEC-6 program by the use of Manning's roughness coefficient "n". Under project channel conditions, three different reaches were considered in terms of the roughness coefficient. The first reach was the channel ocean reach with soft bottom channel and vertical concrete floodwalls at the lower end. The second reach was the rectangular concrete lined channel downstream of the confluence with Santiago Creek, and the third reach was the trapezoidal soft bottom channel drop structure reach from Santiago to the improved channel inlet. The "n" values used in the calibration procedures were numerically estimated using Cowan's method described in Chow's Open Channel Hydraulics (ref. 2) and adjusted to produce the historical bed change. These "n" values would be utilized in the channel ocean reach and drop structure reach; however, they would not be applicable to the concrete lined reach.

5-16 In a concrete lined channel with ephemeral high velocity flow, the standard procedure would be to design the channel using a Manning's roughness coefficient of 0.014. The deposition of sand on the concrete invert could increase this value. If the amount of deposition is less than 0.5 feet, then the increase would be due mainly to grain resistance. Otherwise, any amount greater than this would result in the possibility of bed formation, that is, the development of ripples, dunes, or antidunes, which would cause form drag and increase the resistance to flow. From the initial HEC-6 runs, the amount of deposition was found to be generally greater than 0.5-foot. Deposition would occur in the lower (downstream) portion of the concrete channel reach from station 257+00 downstream to station 150+50. Therefore, the Manning's "n" value would be adjusted to account for bed forms. The remaining part of the concrete channel reach would not experience deposition and be designed with the standard "n" value of 0.014.

5-17 For both the lined concrete and unlined channel ocean and drop structure reaches, the bed forms for various discharges were determined using the methodology by Vanoni (ref. 8). The result of the bed form analysis indicated that at high flows, the bed form for the channel ocean reach and lower part of the concrete channel would be in plane bed, while the drop structure reach would be in plane bed or antidunes. From reference 1, the corresponding Manning's "n" values for these bed forms would range from 0.012 to 0.022 for plane bed and 0.015 to 0.031 for antidunes. Moreover, the suggested values for sediment transport analysis were 0.02 for plane bed and 0.025 for antidunes.

5-18 In summary, the Manning's "n" values utilized in the HEC-6 computations for the Santa Ana River were 0.02 for the unlined channel ocean reach and the deposition portions of the lined concrete channel reach, 0.014 for the concrete channel reach without deposition and 0.025 for the drop structure reach. The effect on the "n" value from the revetment on the side slopes was not investigated because the side slope "n" value applied against the riverbed would not significantly change the composite "n" value. It should be noted that no significant vegetation will be permitted in the channel. Operation and maintenance clearing of vegetation and brush over 3 feet high is required. Low flows will bend over and uproot smaller vegetation. In addition, the current practice using temporary diversion levees located within the channel for ground water recharge at low flows will be permitted since uncompacted sand levees historically wash out at relatively low floodflows of 2,000 cfs.

Results

GENERAL

5-19 The results obtained from the HEC-6 simulation of the design flood as well as the lesser frequency floods appear to be reasonable. Since it is beyond the state-of-the-art capability to accurately predict the scour or deposition at specific locations, the results presented herein

are in terms of the general trends of aggradation and degradation. To ensure that the results are applicable in design, a sensitivity analyses was conducted of various transport parameters in the HEC-6 program which influence the sediment transport calculations. In addition, various channel conditions were investigated since it is possible that the channel would not be at the design invert at the start of the design flood.

DESIGN FLOOD

5-20 The HEC-6 simulation of the design flood was conducted for the reach from the improved channel inlet at Weir Canyon Road downstream to the Pacific Ocean using two different cases of sediment inflow since the sediment inflow would be variable over the project life. The two cases are the maximum and minimum sediment inflow into the improved channel reach. The objective was to bracket the trend of aggradation and degradation within the channel for use in hydraulic design.

5-21 For the case of the maximum sediment inflow, the results of the HEC-6 analysis indicate that at the peak of the design flood, deposition would be significant just downstream of the improved channel inlet and at the lower end of the concrete channel and channel ocean reach. For the first drop structure reach (stations 1204+70 to 1157+60), the depth of deposition would be up to 2.2 feet. The other drop structure reaches show no bed change. In the lower end (stations 242+60 to 0+00), the deposition would be up to 7.3 feet. At the end of the design hydrograph, there are some additional subreaches in the drop structure reach that experience deposition. The overall sediment depths were 1 to 2 feet higher. In the channel ocean reach and downstream end of the concrete channel, the depositional slope ranged from S = 0.0006 to 0.0012 at the peak flow and at the end of the design hydrograph. The depositional slope of 0.0012 compares favorably with the historical slope of S = 0.0011. As a result, the preliminary design depositional slope was selected as that slope that was present at the maximum river water surface elevation, which for all reaches coincided with the peak of the design hydrograph. The preliminary design slope was tested and further refined in the sensitivity part of the analysis. The design of the channel levee heights could be established with these results.

5-22 In contrast, the HEC-6 analysis for the minimum sediment inflow was performed by using a zero value for the inflowing load from all sources. The results indicate a potential for general scour of up to 8 feet below the design invert between invert control points in the upstream reach of the drop structures (station 1204+20 to 1157+60). In the reach just downstream of the concrete-lined channel (channel ocean reach), the scour would be up to 6 feet below the design invert. Although this is an extreme opposite of the analysis above with sediment inflow, the result provides for design of the slope protection toe depths in this reach.

SENSITIVITY ANALYSIS

5-23 Because of the uncertainties involved in the sediment transport theory, additional sensitivity analyses were made of the various HEC-6 program input variables and of various channel conditions likely to occur preceding the design event. The program parameters include the roughness coefficient "n" and the bed-material gradation. The alternative channel conditions include the formation of a sand plug at the ocean outlet, initial deposition in the channel, and high and low downstream water surface elevations with respect to tidal fluctuation.

Roughness Coefficient "n"

5-24 As previously discussed in paragraphs 5-15 to 5-18, the "n" values used in the analysis were based on the channel conditions including the effect of bed forms. To ensure that the improved channel will function in terms of deposition on the bed during the design flood, the "n" value was increased to 0.03 in all reaches of the HEC-6 model. The higher value will result in reduced sediment transport capacities which in turn may result in higher deposition. The result of the computations indicate that the quantity of channel aggradation is not sensitive to the "n" value. The deposition with n = 0.03 was less than or equal to the design deposition amount.

Bed Material Gradation

5-25 The bed material gradation used in the analysis was based on a graphical average of the samples obtained directly from the streambed. The sensitivity of the gradation was examined by increasing the size fraction of the larger particles such that the $\rm d_{50}$ particle size increased from 0.5 to 0.75 mm. The amount of increase was based on the gradation range of the individual samples. The amount of aggradation was found to be insensitive to the increased particle size. The deposition for particle size of $\rm d_{50}$ equal to 0.75 mm was less than or equal to the design deposition amount.

Sand Plug

5-26 Under existing conditions, the littoral drift of sand across the ocean outlet forms a sand plug that reduces tidal ocean waters from flushing in and out of the river. To address the impact of this plug forming under project conditions, the HEC-6 analysis geometric data was adjusted by estimating that the sand would deposit up to elevation 0.0 feet NGVD for the entire lower reach. The design invert daylights at elevation 0.0 feet NGVD approximately 1.9 miles upstream from the outlet and drops to elevation -7.0 feet NGVD at the stabilizer near the ocean outlet. The results of the computations indicate that the sand plug would wash out before the peak of the design flood. The amount of aggradation did not exceed the design deposition slope.

Antecedent Flow

5-27 In addition to a sand plug forming, deposition in the channel ocean reach could also form as a result of lower frequency floods or antecedent floods preceding the design event. In order to simulate the initial movement of sediment prior to the design event, a flow of 5,000 cfs for a period of 38 days, which represents the volume of water to empty Prado Basin, was considered applicable. The flow rate of 5,000 cfs corresponds to historic releases. The sediment deposition during the design flood was quite sensitive to the initial bed conditions. It was found that the quantity of deposition in the channel ocean reach was twice the amount with antecedent flow than without. As a result, a new depositional design slope was determined. It is important to note that this new depositional design slope was considered as the final design slope for use in the subsequent hydraulic design for computing water surface elevations. Plate 11 graphically displays the channel invert profile and the sedimentation profiles for the hydraulic design of the channel at peak design discharge. At the end of the design hydrograph, there are some additional subreaches that experience deposition. Plate 12 graphically presents these results. Plate 12 is provided for trend information only and is not intended to be used in the hydraulic design.

Tidal Influence

5-28 The fluctuation of the starting water surface elevations (WSEL) for backwater computations could influence the sediment transport characteristics and capacity of the downstream channel as noted in a paper by Dixon et al (ref. 30). In the Los Angeles District, the current design practice for the starting WSEL is to use the peak discharge of the design event coincident with the mean higher water (MHHW) elevation above mean-sea-level (MSL). A starting WSEL of 2.54 ft. MHHW was used in this analysis throughout the design hydrograph. To examine the sensitivity of this value with respect to sediment deposition in the downstream channel, an evaluation of the peak flows and higher high tides was conducted using tidal data obtained from NOAA (ref 31). The tidal data was in the form of a statistical month based on 17 years of recorded data at Newport Beach, which is just south of the outlet channel. The timing of the starting WSEL in the model was adjusted such that the peak flow for the design flood hydrograph was coincident with peak MHHW of the statistical month tidal hydrograph. Plate 13 graphically displays the tidal hydrograph. The peak MHHW is about 4.22 ft (MSL Datum), which is only 1.68 ft higher than design condition. The results of the computation indicate that aggradation is not sensitive to the fluctuation. The reason is because the tidal hydrograph fluctuate more rapidly than the design flood hydrograph. The fluctuation in downstream WSEL cause less backwater at low tide levels and transports the aggraded sediment further into the ocean.

6. AVERAGE ANNUAL DEPOSITION AND SAND OUTFLOW TO THE PACIFIC OCEAN

Methodology and Results

6-01 An analysis was conducted to determine the average annual aggradation in the project reach and the sand outflow to the Pacific Ocean for maintenance and mitigation measures as a result of the project. Estimates of average annual aggradation and sand outflow for the with and without improved channel (project) conditions over the project life were determined using the weighted incremental probability method. Estimates of average annual aggradation and sand outflow for historical conditions after closure of Prado Dam in 1941 were performed using existing available data.

6-02 For the with project condition, the incremental probability method is applied by evaluating the 10-, 25-, 50-, 100-year floods, and the design flood, which has a frequency of 170-year, with the HEC-6 program to determine the volume of deposition and sand outflow for each flood. The sediment volumes are then weighted by the incremental probability of occurrence for any given year by the relationship:

$$Qs_{annual} = .006 (VOL_{170}) + .004 \frac{(VOL_{170} + VOL_{100})}{2} + .01 \frac{(VOL_{100} + VOL_{50})}{2} + .02 \frac{(VOL_{50} + VOL_{25})}{2} + .06 \frac{(VOL_{25} + VOL_{10})}{2}$$

Where Qs is average annual (deposition or sand outflow) and the 170-, 100-, 50-, 25-, 10- are the subcripts for floods with their respective return period in years. Floods less than the 10-year flood were not included in the analysis because these smaller floods would not contribute a significant quantity of sediment in terms of channel deposition or sand outflow. Under improved channel conditions, the average annual channel deposition and sand outflow to the Pacific Ocean were estimated to be 31,000 and 36,000 cubic yards, respectively. The total of the two is 67,000 cubic yards.

6-03 For the without project condition, the same procedures were applied as for the with project condition except for the design flood. In this case the design flood would cause levee failure of the existing channel, resulting in sediment exiting into the flood plain. The sediment volumes, not including the design flood, are weighted by the incremental probability occurrence by the relationship:

$$Qs_{annual} = 0.01 (Vol_{100}) + 0.01 \frac{(Vol_{100} + Vol_{50})}{2} + 0.02 \frac{(Vol_{50} + Vol_{25})}{2} + 0.06 \frac{(Vol_{25} + Vol_{10})}{2}$$

6-04 The without project average annual deposition and sand outflow to the Pacific Ocean were estimated to be 24,000 and 25,000 cubic yards, respectively. The total of the two is 49,000 cubic yards. By not including the design flood, the difference of 18,000 cubic yards (67,000 minus 49,000) reflects the average annual deposition into the flood plain. It should be noted that this figure is a gross estimate since it does not include wash load and it does not account for timing of the levee breach during the design event.

6-05 The average annual deposition and sand outflow under historical conditions were computed by using data from stream gage and historical channel removal records. For the period from 1941 to 1971, an estimate of the coarse sediment discharge was made by the USGS (ref. 6) for the stream gage at Fifth Street in Santa Ana. The estimate was adjusted by the Corps of Engineers by including sediment outflow to represent the period up to 1978. The adjusted sand discharge at the gage was about 140,000 cubic yards per year. From reference 15, the estimated average annual sand deposition downstream of the gage for about the same time period was 60,000 cubic yards per year. Thus, subtracting the deposition yield from the sand discharge yield produces an estimated average annual sand outflow of 80,000 cubic yards per years. It is important to note that these estimates would slightly increase with the inclusion of the recent flood events. However, an attempt to include these events was found to be difficult because of the problem with the streamgage records at Fifth Street during 1980 flood and the channel scour downstream of the gage producing an additional source of sediment. Consequently, the above values without the recent floods were considered reasonable for the long term historical average.

6-06 The average annual deposition and sand outflow for the with and without project channel conditions were estimated with the equation noted previously. The deposition was found to occur in the lower 4 miles of the project channel. Table 9 summarizes the deposition and sand outflow quantities for with and without project conditions and for historical conditions.

Table 9. Sediment Yields for Various Floods.

Channel Condition	Flood (year)	Sediment Deposition (X 1000 yd ³)	Sand Outflow (X 1000 yd ³)
With project	170 100	1,509 679	2,303 524
	50	367	324
	25	180	195
	10	39	54
	annual	31	36
Without project	170	1/	1/
	100	_484	<u>9</u> 23
	50	340	336
	25	231	136
	10	90	11
	annual	24	25
Historical Condition			
(1941–1978)	annual	60	80

^{1/} Not included in annual computations because flood would breach levees, resulting in sediment exiting the channel system.

Comparison With Average Annual Yield Calculations for the Santa Ana River Canyon

6-07 In order to determine the reasonableness of the estimate of the with-project average annual sediment production, a comparison was made between the sediment yield estimate of the canyon reach with the project yield. As discussed in paragraph 4-21, several methods were used to estimate the canyon sediment yield. From that analysis, it was determined that the sand sediment yield would range from 43,200 to 52,800 cubic yards per year. The with-project sand sediment yield of 67,000 cubic yards per year compares favorably and would be considered very reasonable with respect to the sediment yield of the canyon. In other words, the difference in sediment yield estimates of about 30 percent is well within the accuracy in sediment transport technology with respect to sediment yield determination.

Frequency of Cleanout

6-08 As part of maintenance requirements for the channel design, an upper grade limit was established to identify the sediment removal required from the channel to maintain the design flood protection. Sediment would be allowed to accumulate to the upper grade limit line shown on plate 14. Once sediment deposition exceeds this limit, the sediment must be removed to the design invert.

6-09 The upper grade limit was based on the bed change in the HEC-6 analysis after antecedent flow of 5,000 cfs for 38 days. The bed change encompassed a deposition bed slope of 0.0007986. This corresponds to a deposition volume of about 660,000 cubic yards. Based on the average annual sediment deposition of 31,000 cubic yards per year, the channel in the lower reach would have to be cleaned out on the long term average of once every 21 years.

6-10 The upper grade limit was raised to elevation 0.0 feet msl in the reach downstream of where the upper grade limit crosses elevation 0.0 at station 69+33. The adjustment was made to allow sediment to accumulate upstream of the sand plug that usually forms at the river mouth. This geometric condition was also tested in the design HEC-6 analysis. The resulting bed change did not exceed the design deposition amount. Therefore, sediment will be allowed to accumulate to the adjusted limit. No sediment removal maintenance is expected in the drop structure concrete channel reach from the inlet at Weir Canyon Road downstream to the concrete channel station 223+35.

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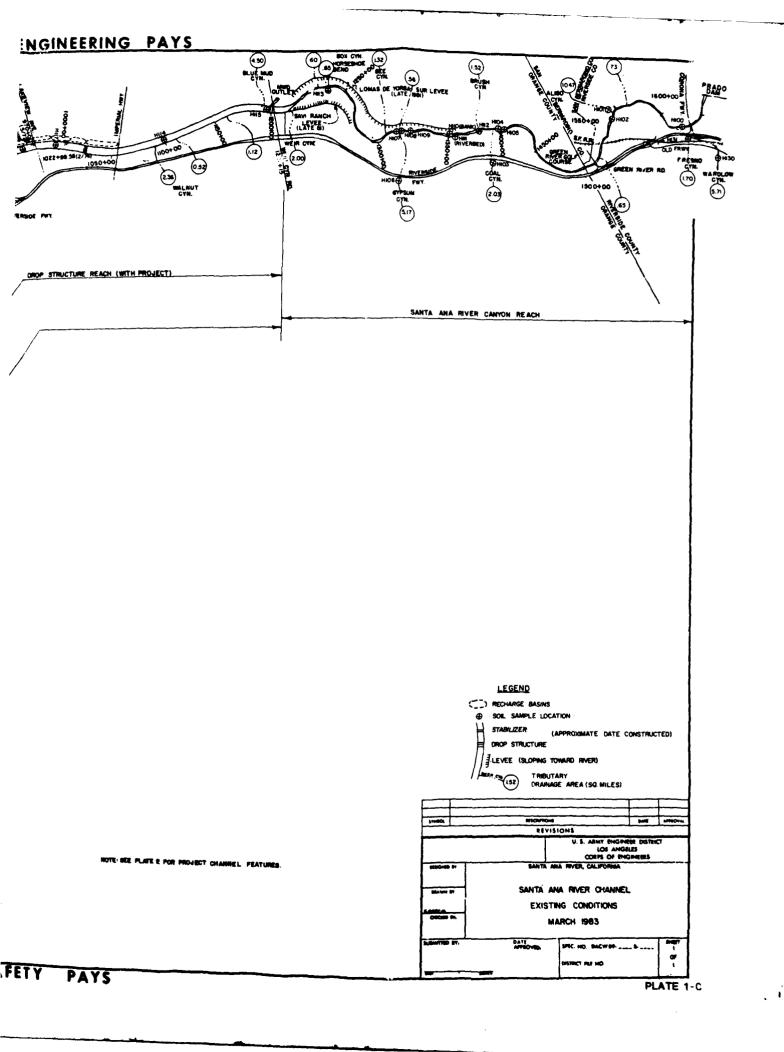
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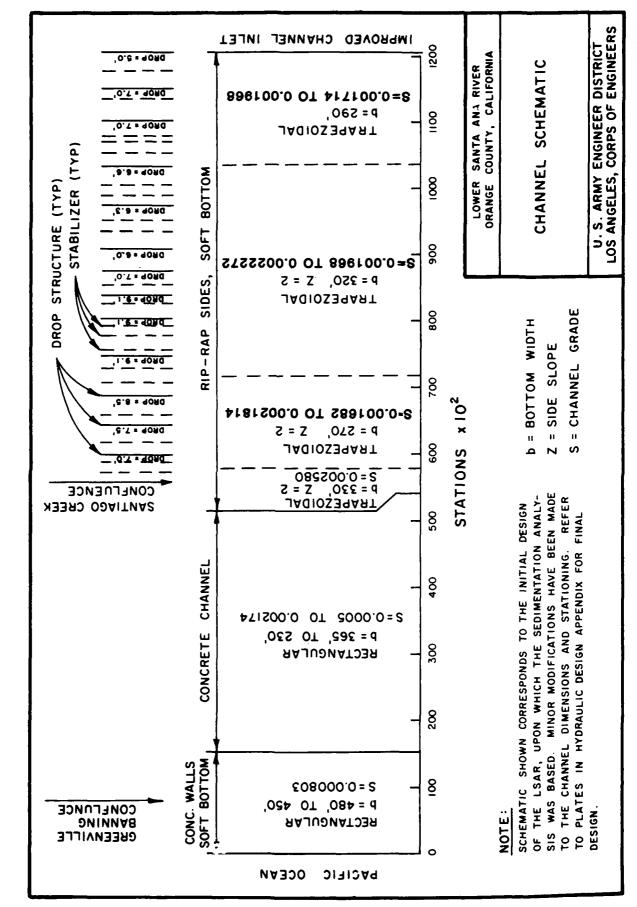
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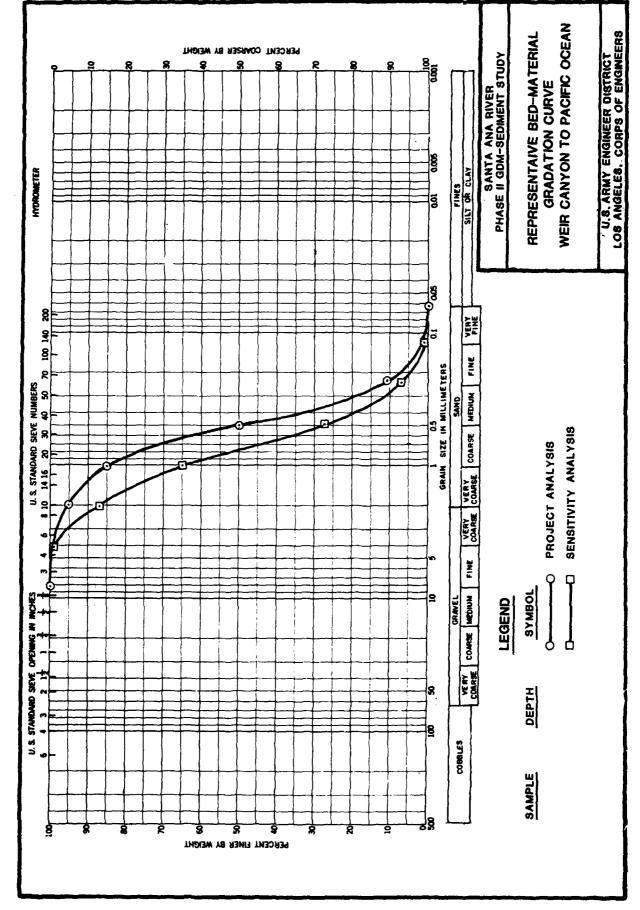
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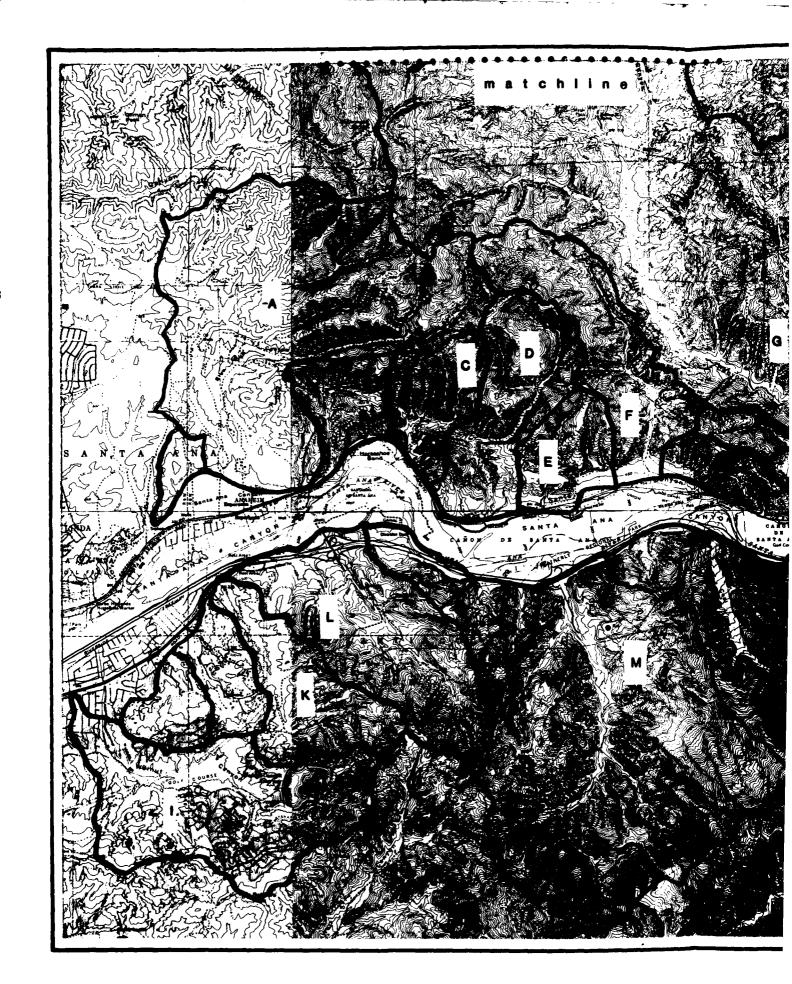
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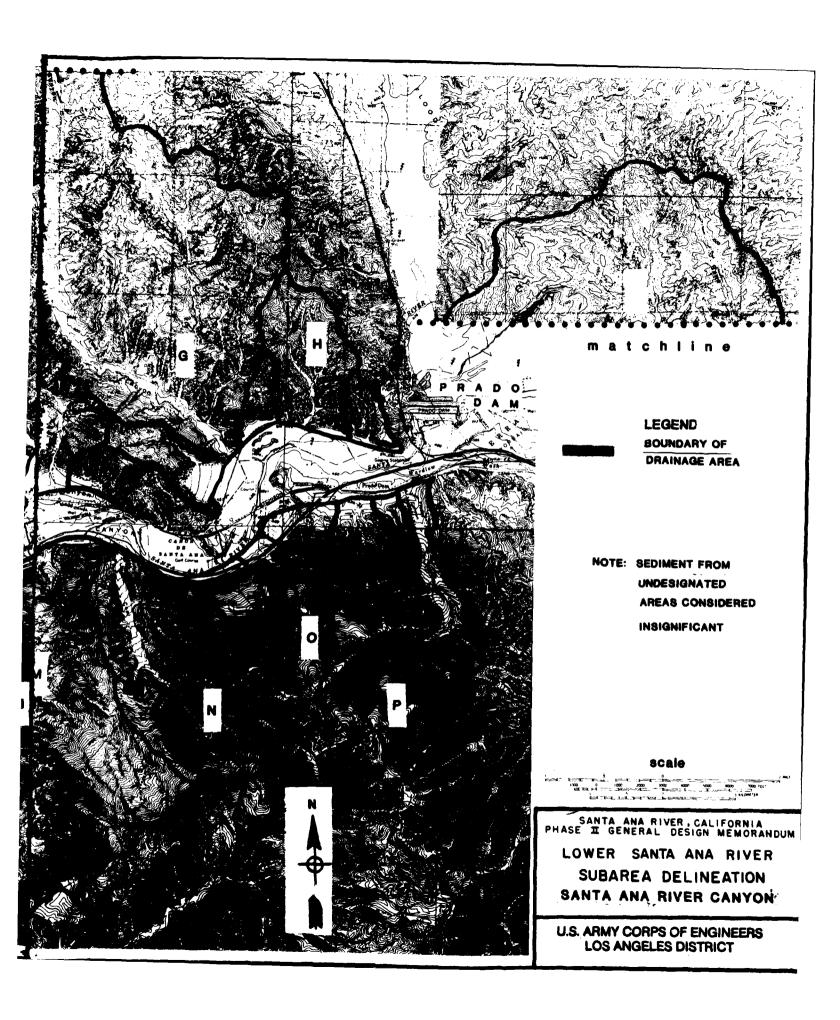
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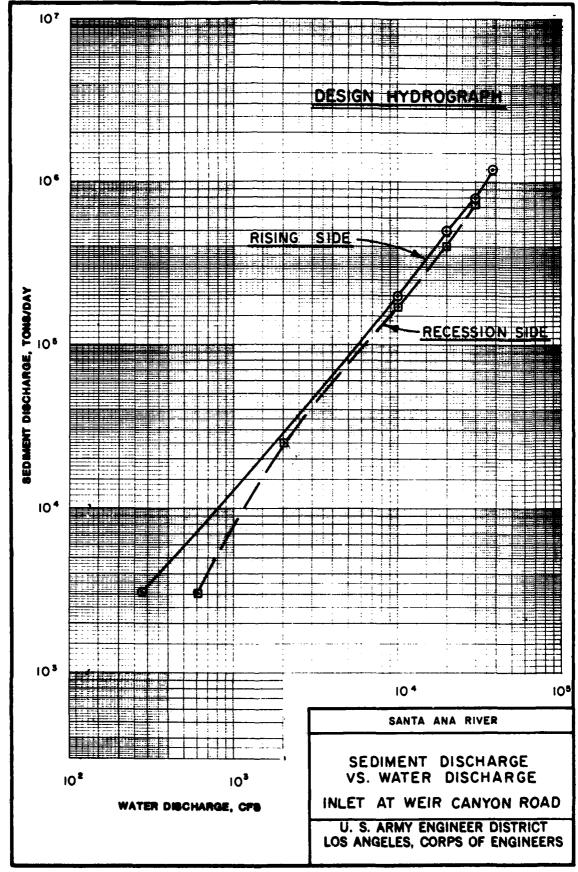


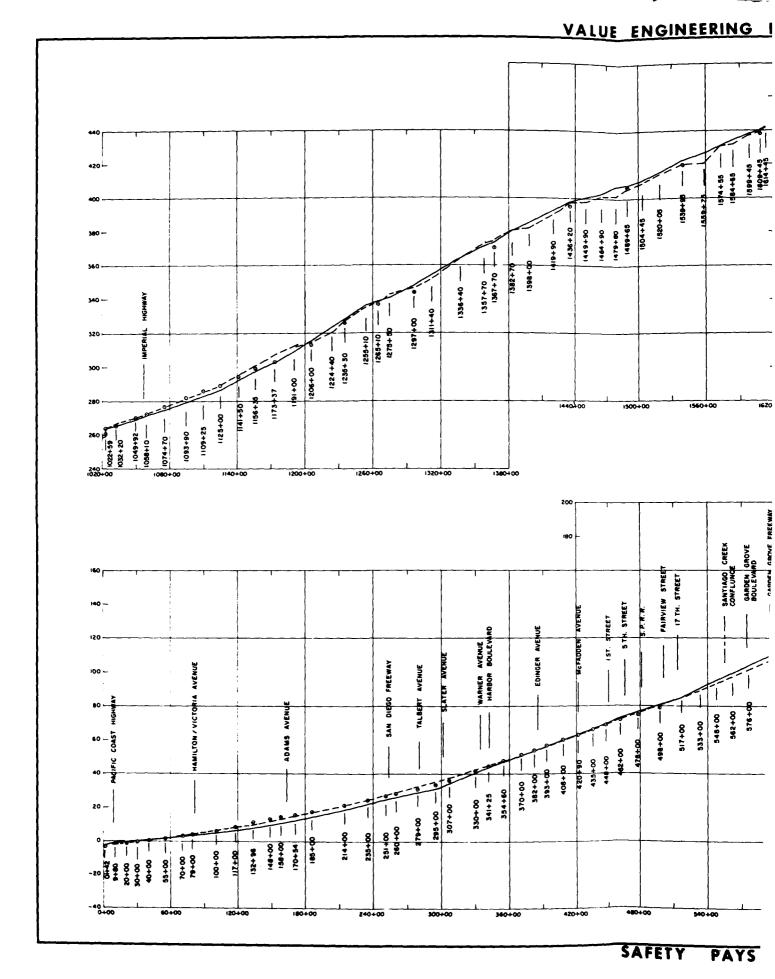




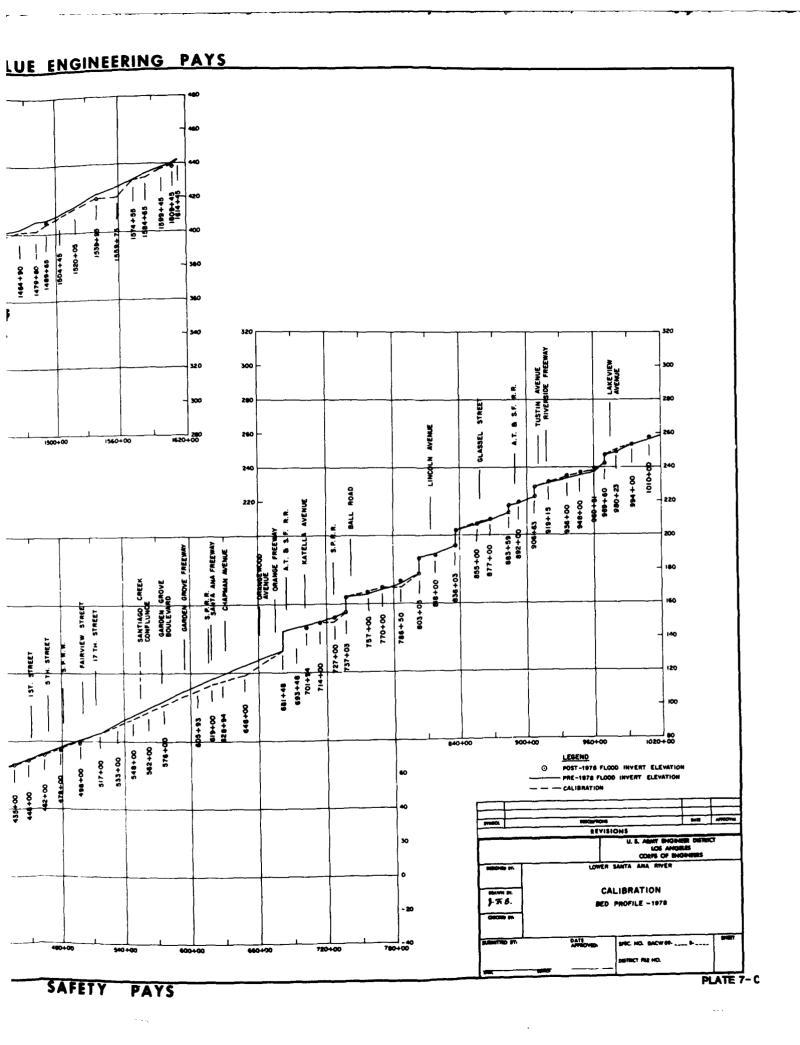
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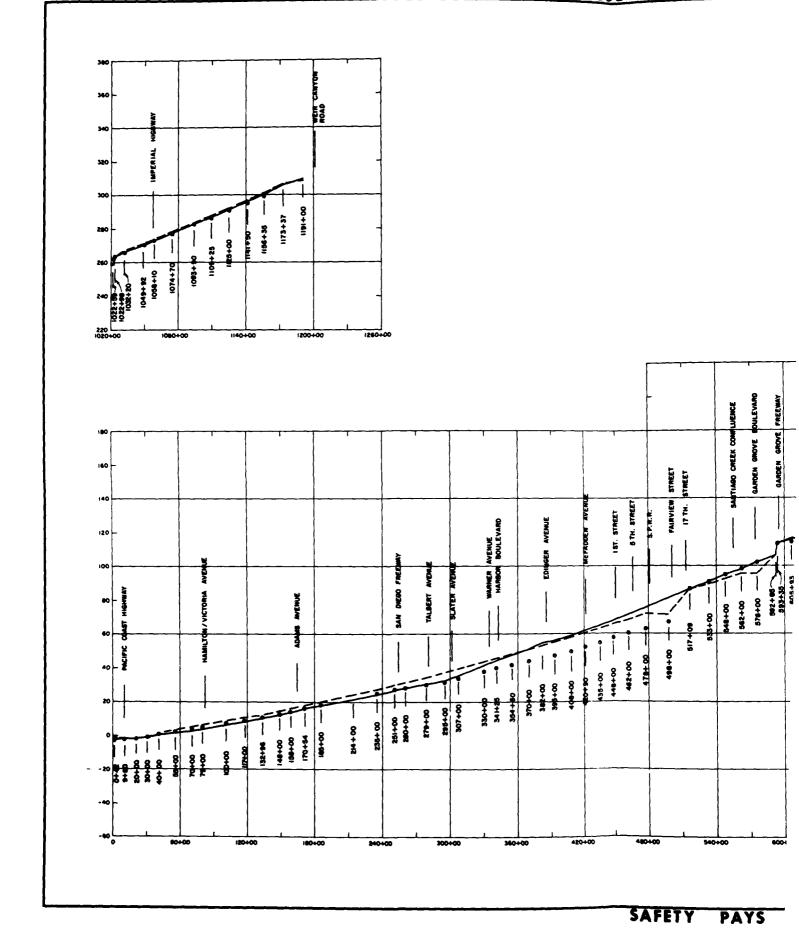
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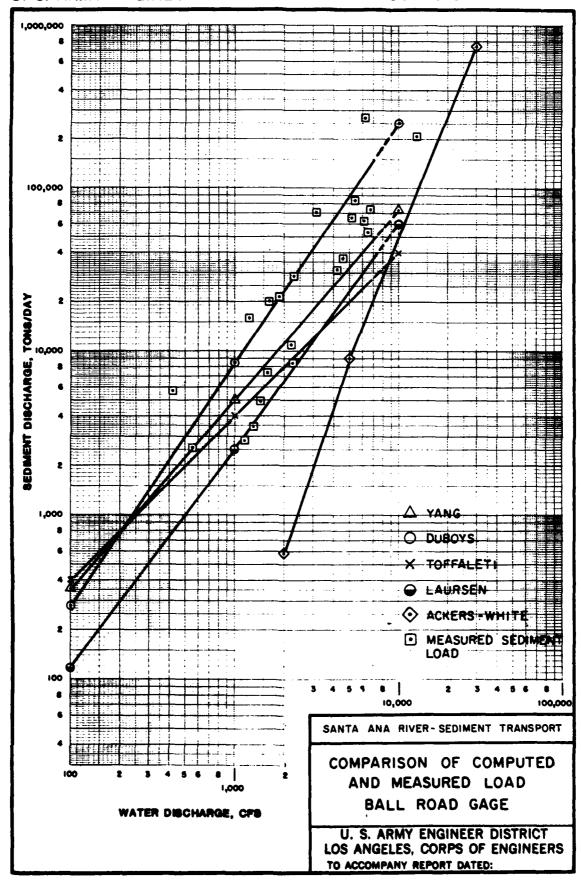
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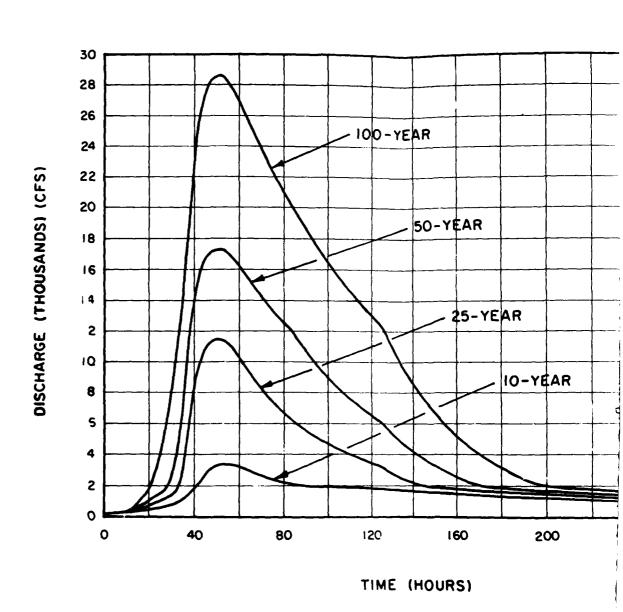


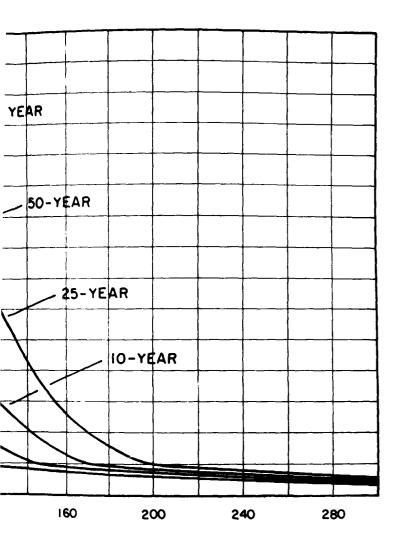


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SANTA ANA RIVER

BALANCED HYDROGRAPHS

U. S. ARMY ENGINEER DISTRICT LOS ANGELES, CORPS OF ENGINEERS

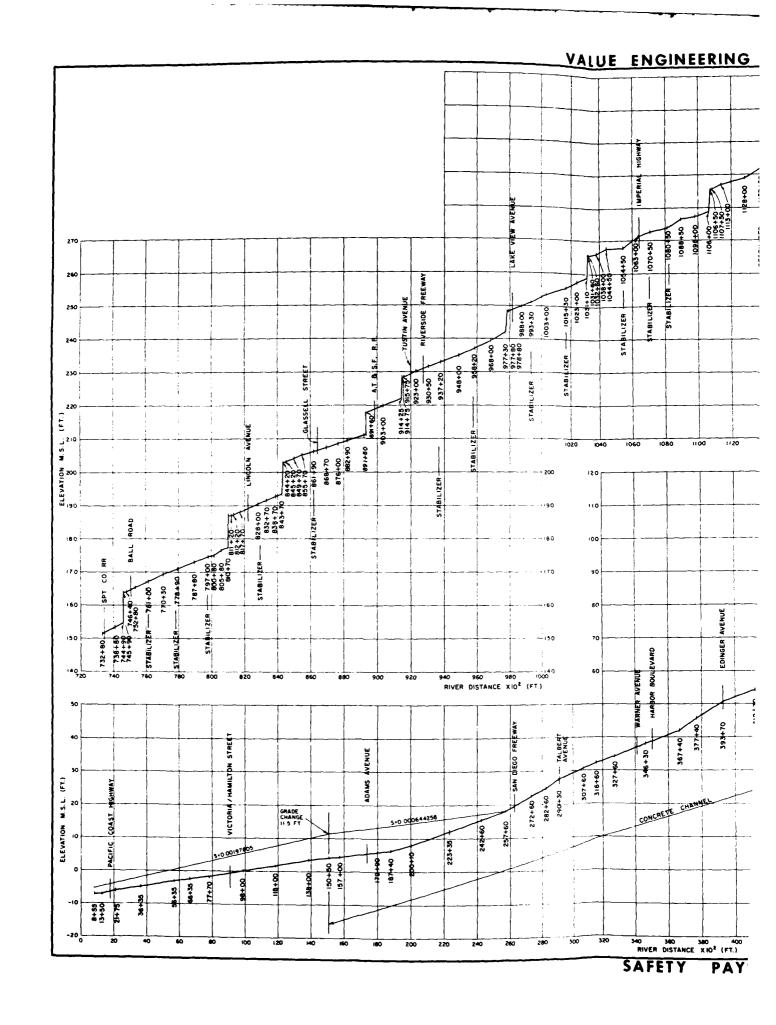
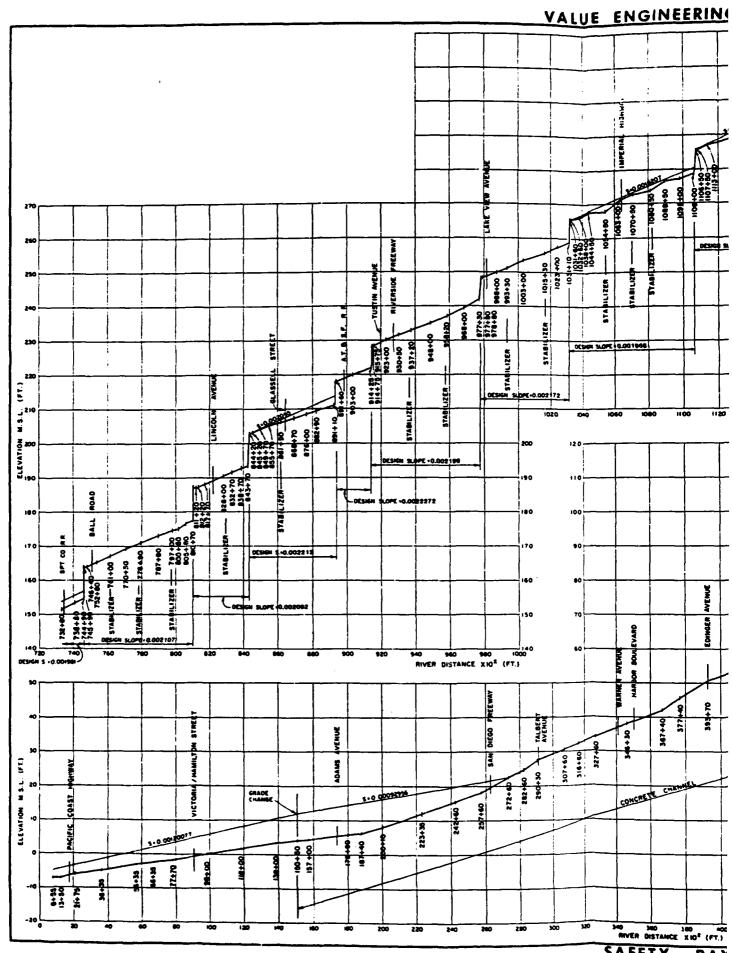


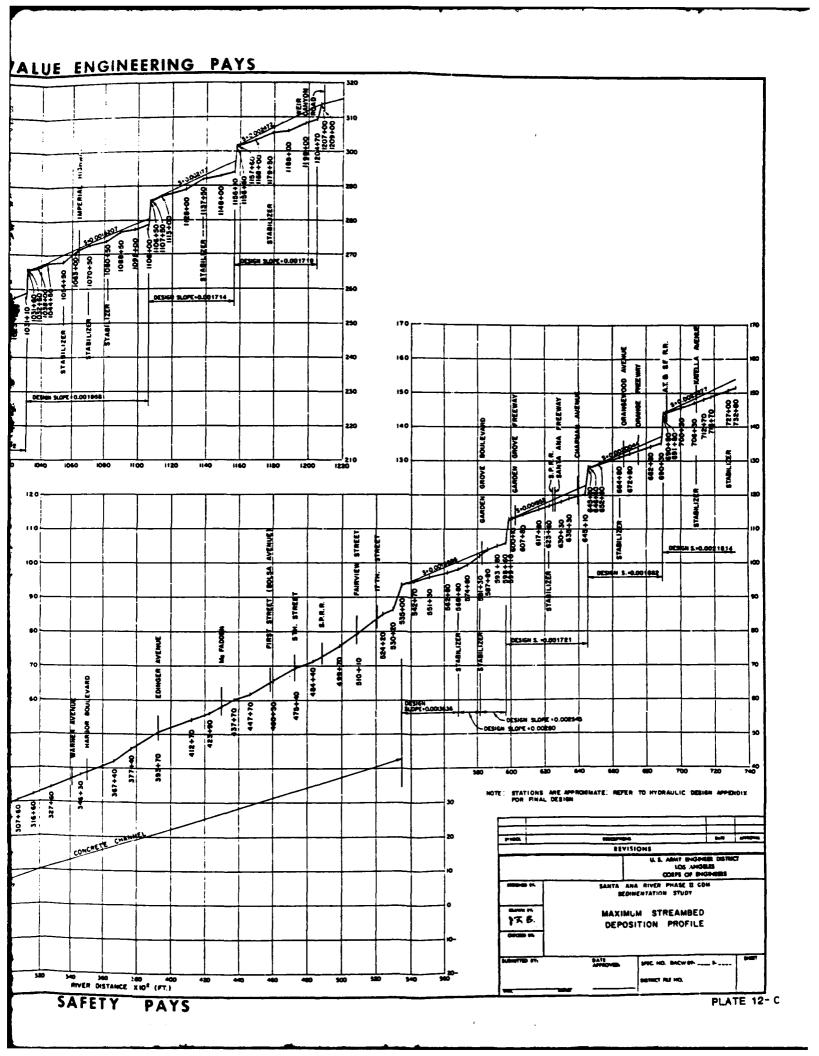
PLATE 11-C

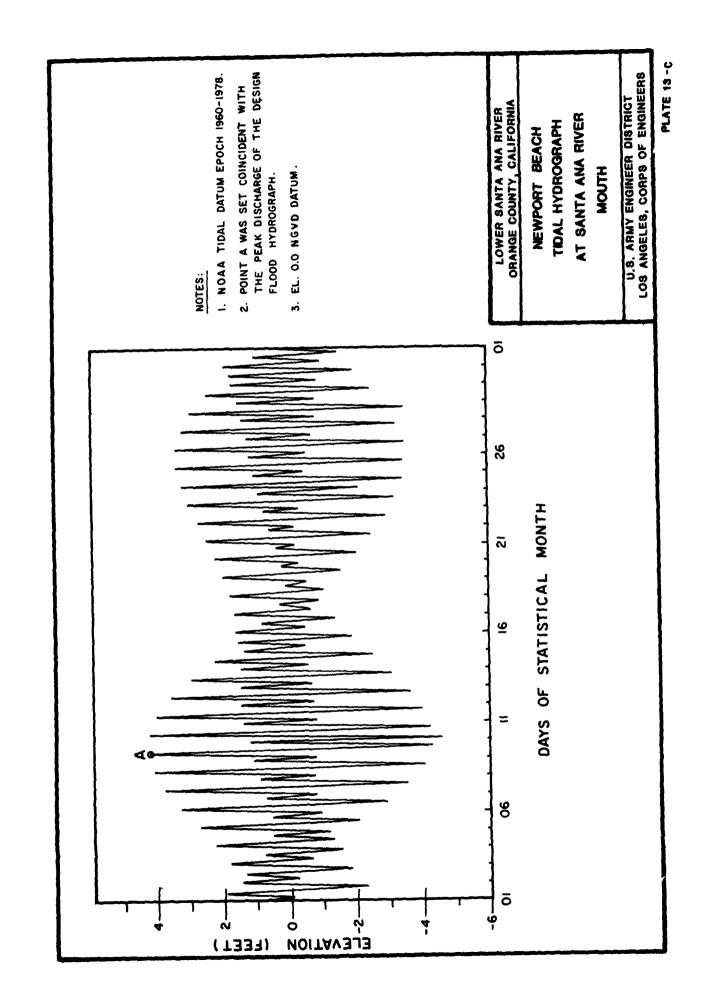
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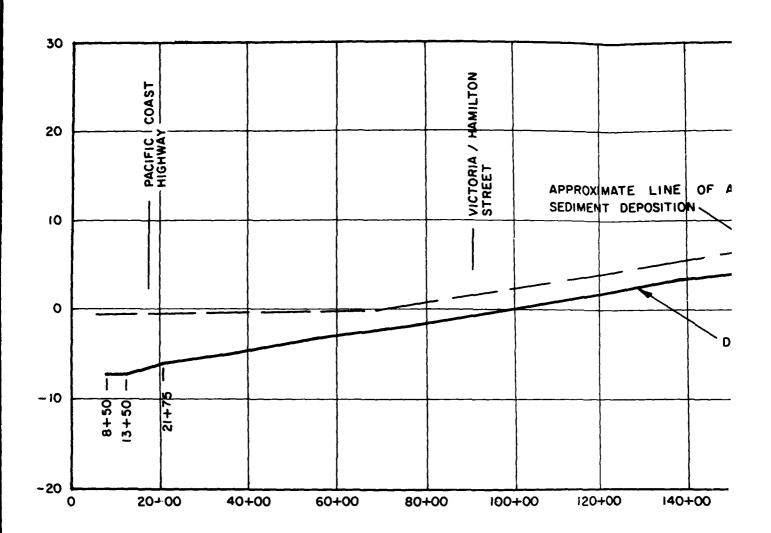
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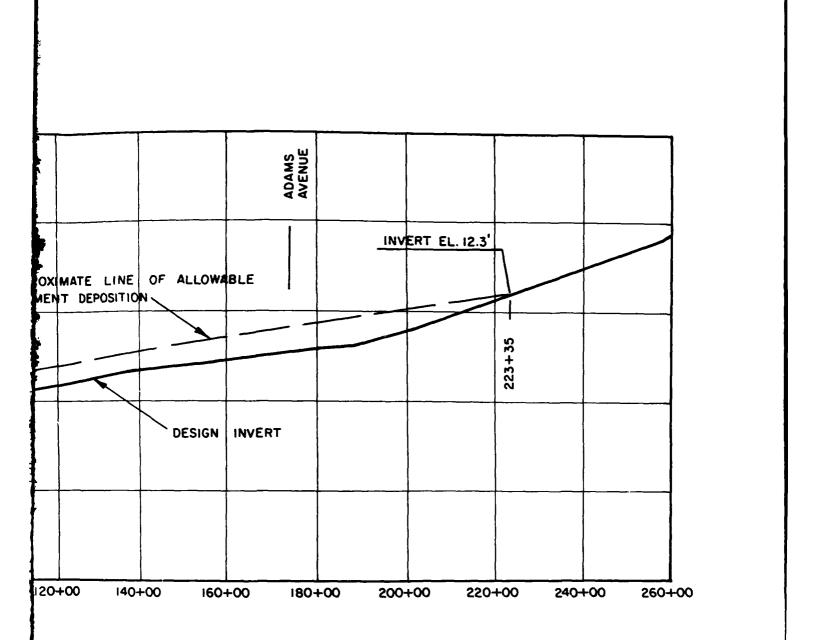






PROFILE

HORIZ. SCALE: IIN. = 200 VERT. SCALE: IIN. = 10 F



PROFILE

SCALE: IIN. = 2000 FT. SCALE: IIN. = 10 FT.

> LOWER SANTA ANA RIVER ORANGE COUNTY, CALIFORNIA

UPPER SEDIMENT LEVEL

STA. 8+50 TO STA. 223+35

U.S. ARMY ENGINEER DISTRICT LOS ANGELES, CORPS OF ENGINEERS

C Sediment Transport Analysis

ATTACHMENT

FINAL REPORT

REVIEW OF THE
DRAFT SEDIMENTATION REPORT
OF THE LOWER SANTA ANA RIVER,
PHASE II GENERAL DESIGN MEMORANDUM

Prepared for

Department of Army
Los Angeles District Corps of Engineers
P.O. Box 2711
300 N. Los Angeles Street
Los Angeles, CA 90053

Prepared by

Simons, Li & Associates, Inc. 3901 Westerly Place, Suite 101 Newport Beach, CA 92660

SLA Project No. CA-COE-16 (R1029/N-57)

June 5, 1987

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I. BACKGROUND

The Santa Ana River drains a large, arid watershed and conveys flood water through developed areas valued at many billions of dollars. The lower river is virtually dry most of the year but has experienced peak discharges of up to 327,000 cfs for the flood of January, 1882. The flood of 1938 had a peak discharge of approximately 100,000 cfs and its damage inspired major channelization efforts as well as the construction of Prado Dam. The next major flood occurred in January and February, 1969 and had a peak discharge of approximately 36,000 cfs. The floods of March, 1978 and February, 1980 also caused notable damage.

The Phase I GDM calls for significant improvements to the Lower Santa Ana River. From Weir Canyon Road to the Santiago Creek confluence, the plan calls for a soft bottom, trapezoidal channel with 18 to 24 inch riprap on the banks. From the Santiago Creek confluence to the San Diego Freeway, the channel will be trapezoidal with concrete sides and bottom. From the San Diego Freeway to the river mouth, the channel will be rectangular with concrete sides and a soft bottom. Since this portion of the river has historically been a reach of deposition, there is no need for lining the bottom of the channel.

II. DESCRIPTION OF SEDIMENTATION STUDY

The objectives of the sedimentation study for the Lower Santa Ana River design include the following:

- (1) Convey flood waters safely to the ocean without overtopping in the main stem or its tributaries.
- (2) Account for erosion of the river bed and banks durings a flood event.
- (3) Account for local scour at road crossings, tributary inflows, etc.
- (4) Estimate maintenance involved in removing large quantities of sediment in deposition reaches, especially near the river mouth.

Because of the relationship between hydrualics and sediment transport, it is important to incorporate their effects upon each other into the project design. In order to analyze this complex problem correctly and completely, the following approach was used by the Los Angeles Corps of Engineers.

- (1) Assess the behavior of the existing Santa Ana River using available data and historical accounts of previous floods.
- (2) Use measured data such as flood stages and sediment concentrations to determine the applicability of the HEC-6 computer program "Scour and Deposition in Rivers and Reservoirs."
- (3) Determine the response of the proposed project to the design flood using HEC-6. Areas of scour and deposition should, in general, correspond to historical events.
- (4) Use several qualitative and quantitative methods in addition to numerical modeling to perform sedimentation analysis to provide support for conclusions drawn.
- (5) Conduct a sensitivity analysis by varying parameters that have a large uncertainty such as roughness and sediment loading. Determine the effect of these variations on the computed solution.

This approach is thorough and systematic. It uses available historic data and uses several different analysis methods to verify the results. The following chapter is a summary of the results and procedures of the Phase II GDM sedimentation report for the lower Santa Ana River.

III. SUMMARY OF LOWER SANTA ANA RIVER SEDIMENTATION REPORT

The study was conducted by the Los Angeles District Corps of Engineers, Engineering Division, Hydraulics/Hydrology Branch. A summary of the Corps of Engineers' study follows.

The study reach starts from the river mouth at the Pacific Ocean and ends at Prado Dam approximately 31 miles upstream. From the ocean to river mile 23, the river is channelized with both concrete and revetted side slopes and a soft bottom. From river mile 24 to Prado Dam there is essentially a natural channel through what is known as the Santa Ana River Canyon. Santiago Creek is the main tributary and it enters at approximately river mile 11.

Data collection efforts turned up maintenance records that indicate the average annual sediment deposition in the study reach is 55,000 cubic yards per year. Aerial photos were available for 1982, 1974 and 1938. Bed material analysis indicates about 90% sand and 10% gravel. Channel surveys were performed after the 1978 and 1980 flood events. Project channel geometry was taken from the Phase I GDM. Streamflow data was recorded below Prado Dam, at Imperial Highway, at Ball Road and at Fifth Street. Suspended sediment measurements were also made at these gaging sites. The gage measurements were corrected to account for the unmeasured sediment load.

A qualitative analysis using the Lane relationship indicated the upper portion of the channelized project reach will experience aggradation; the area just upstream from the Santiago Creek confluence will remain stable; the all concrete reach will maintain its design invert elevation; and deposition will occur downstream from the San Diego Freeway. The results are shown in Table 2 of the Corps study.

An equilibrium slope analysis using Yang's equation yields general results similar to the qualitative analysis. It was determined that bed armoring would be unlikely to occur during the design flood due to the relatively small representative grain size. Table 4 indicated the armor grain size is between 10 and 70 mm. The dgs grain size however is 2 mm.

A limiting degradation slope was estimated using 4 different methods: Schoklitsch bedload equation, Meyer-Peter Muller bedload equation, Shields diagram and Lane's critical tractive force method. These methods yielded stable slopes of 0.000029, 0.0000029, 0.0000073 and 0.000004 respectively.

A relationship between sediment discharge and water discharge was developed. It incorporated all sediment sources in the canyon reach upstream from

the proposed project. Stream gage data was available for sediment loads for discharges up to 14,000 cfs. The computer program HEC-6 was used to estimate sediment loads for higher discharges. Tatum's method was used to estimate sediment yield from the watershed during a design storm. Bank erosion estimates were made by examining aerial photographs. The Pacific Southwest Interagency Committee method and the Flaxman method were also used to estimate sediment yield. A sediment yield rate of 1.64 acre-feet/square-mile/year was determined for the canyon watershed above the project reach. This compared well to reservoir deposition data indicating a 1.45 acre-feet/square-mile/year sediment yield rate at nearby Santiago Reservoir. An average annual sediment inflow of up to 132,000 cubic-yards/year was determined to enter the project reach. Note that this number includes sand, silt and clay sizes.

Sedimentation analysis was carried out using the Corps of Engineers computer program HEC-6 and a modified version known as H6NBS36. The geometric data covered the project inlet at Weir Canyon Road to its outlet at the Pacific Ocean. The program was calibrated using data from the flood of 1978. Yang's unit stream power method was used as a transport function in HEC-6. The calibration was performed by adjusting the Manning's n value of each section until agreement was obtained between computed and observed bed changes. The calibrated data set was verified using records from the 1980 flood. The bed changes were reproduced fairly well except for the reach downstream from the Santiago Creek confluence. In this reach, computed degradation was less than the degradation observed during the 1980 flood.

The data set for the project condition was developed from plans in the Hydraulic Appendix in the Phase I GDM. Grain size analyses were performed throughout the study area and a single representative grain size distribution was used (Plate 3). The project condition was evaluated using balanced hydrographs representing 10, 25, 50 and 100 year frequency flood events as well as the design event. The following roughness values were used for the project condition: n=0.02 for the downstream reach, n=0.015 for the concrete lined middle reach, n=0.025 for the unlined upper reach (drop structure reach). Form drag caused by bed forms was included in the development of n values.

The design flood was simulated for the project condition using the HEC-6 computer program. Two different inflowing load curves were used to encompass maximum and minimum streambed changes. The results indicate that deposition of

up to 2.2 feet will occur in the upstream reach. Deposition of up to 7.3 feet will occur in the downstream reach. The middle reach remained fairly stable. Note that all three reaches are channelized. A second simulation using clear water inflow indicated 6 to 8 feet of scour in unlined drop structure reaches. This worst case erosion scenario was used to estimate toe depths of lined banks.

A sensitivity analysis was performed to account for the uncertainties involved in sedimentation analysis. The Manning's n value was increased to 0.03 in all reaches but had only a small effect on computed bed changes. The D50 grain size of the bed material was increased from 0.5mm to 0.75mm but this also had little effect on the computed results. The reason for this is because all reaches with unlined channel bottoms experienced deposition thus bed grain size should have no effect upon solutions computed by HEC-6. A sand plug often forms at the Santa Ana River mouth during the summer months. The sand plug would wash out before the peak of the design flood. An antecedent flow of 5,000 cfs for 30 days resulted in twice as much deposition near the river mouth during the design flood event. A tidal elevation of 2.72 feet was used for the downstream boundary condition for the design event. Variations in the tidal elevation had little effect on the riverbed near the ocean.

The incremental probability method was used to compute the average annual sand outflow to the ocean and the average annual deposition in the project reach. The results indicated that 31,000 cubic yards of sand per year deposited in the project reach. The sand outflow to the beach was 36,000 cubic yards per year. From gage records, it was estimated that the sand outflow to the ocean is 80,000 cubic yards per year. It was estimated that the frequency of maintenance in the downstream reach would be approximately every 20 years. No maintenance is expected in the upstream or middle reaches.

IV. REVIEW OF SEDIMENTATION ANALYSIS

4.1 Qualitative Analysis

A qualitative analysis using the relationship

$$q_s D_{50} \alpha q S$$
 (4.1)

Where q_c = sediment discharge per unit width

 D_{50} = median sediment size

q = water discharge per unit width

S = channel slope

This relationship is based upon Lane's Work (see Reference 1). Section III B of the Phase II GDM states, "When sediment transport rate increases, degradation will occur and the bed slope will flatten. Conversely, a decrease in one of the right hand side variables will result in a decrease of the sediment transport rate; deposition will occur and the bed slope will steepen." The results shown in Table 2 (Evaluation of Qualitative Response of Santa Ana River) of the COE report are basically correct. SLA suggests that the sentence referenced above be modified to "When the sediment transport capacity increases, degradation will occur. When the channel slope decreases, aggradation will occur."

4.2 Bed Armoring Potential

Five methods were used to compute the particle size for which bed armoring would occur. The size ranged from 10 mm to 70 mm. Only a small amount of coarse material is available so bed armoring is not expected to be a dominant physical process in the project reach below Weir Canyon Road. Bed armoring may occur, however, in the canyon reach above the project, especially at lower sustained discharges. The impact will be to slow down bed erosion in the canyon reach. The COE analysis took into account the potential range of sediment supply and the corresponding slope changes. SLA concurs with the COE analysis.

4.3 Equilibrium Slope Analysis

Yang's unit stream power equation was used to compute the slope for which the bed would be stable. This analysis yields results that can be expected under normal flooding and sediment supply conditions. This is sometimes referred as "dynamic equilibrium" condition. The results generally agree with the qualitative analysis.

4.4 Limiting Channel Slope

The stable slope is estimated based upon incipient motion criteria for a given particle size and represents a situation that may occur if there is little or no inflowing sediment load. This is sometime referred to as "static equilibrium" condition. A stable slope was computed using four different methods. The design discharge was used to compute the expected bed shear. The stable slope ranged from 0.000004 to 0.000029. This is substantially less than the existing average channel slope and could result in general degradation of up to five feet. SLA concurs that this is a conservative estimate of bed erosion and can be used to estimate toe down on bank lining.

4.5 Sediment Discharge Relationships from Stream Gage Data

The USGS measurements were corrected to exclude wash load and to include an estimate for the unmeasured load. Figure 4.1 shows a comparison of the measured sediment load at Ball Road to load curves predicted by various analytical methods. The inflowing load computed by HEC-6 agrees quite well with measured data. Since there are no sediment or discharge gaging stations at the river mouth, SLA agrees with the COE procedure to use the Ball Road gage to estimate sand outflow to the coast.

4.6 <u>Sediment Yield from Canyon Reach</u>

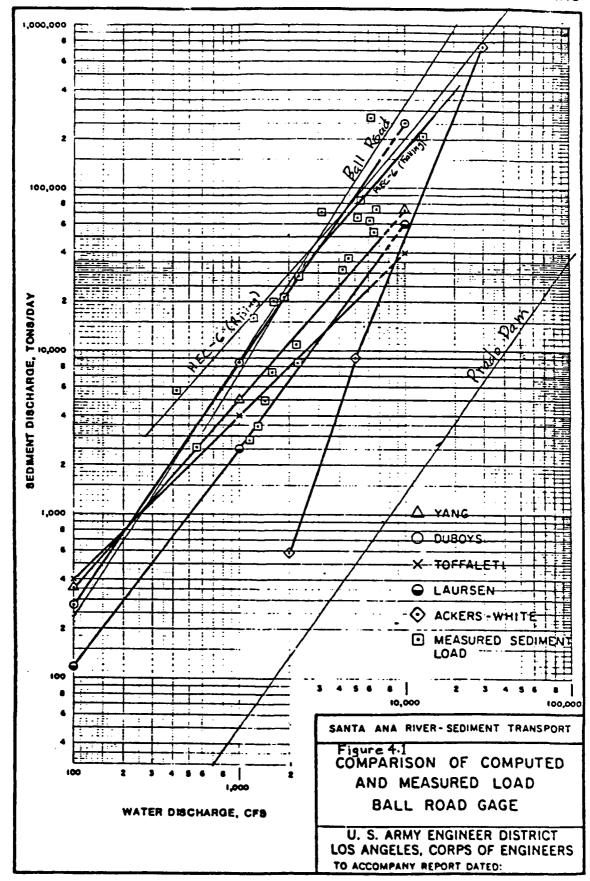
Several techniques were used to estimate the average annual sediment yield from the canyon reach which is just upstream from the project inlet. The Pacific Southwest Interagency Committee (PSIAC) method gave a sediment yield of 1.64 acre-feet/square-mile/year. The contributing drainage area is 42 to 50 square miles. The average annual sediment inflow to the project reach is 108,000 to 132,000 cubic yards/year. The sediment yield estimate based on deposition data from a nearby reservoir indicate a sediment yield rate of 1.45 acre-feet/ square-mile/year. The PSIAC method gives the total sediment yield. The sand yield ranged from 43,200 to 52,800 cubic yards per year. SLA finds that the results of the PSIAC method are resonable based on comparison with the reservoir data.

4.7 Sediment Transport Analysis Using HEC-6

The input data set for HEC-6 was adjusted to reproduce the flood of 1978. The method used was to change the n values until computed bed changes matched

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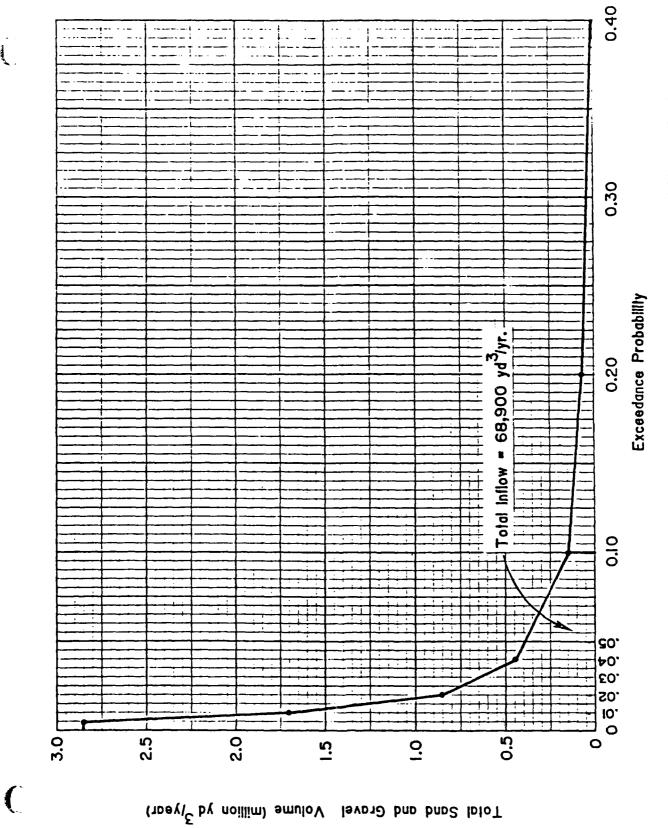


the observed changes. A separate HEC-6 data set was used to reproduce the flood event which occurred in 1980. Although there were slight changes in the channel geometry, the river characteristics were similar during the 1978 and 1980 flood events. The second computer simulation revealed that HEC-6 underestimated the severe degradation that occurred downstream from the Santiago Creek confluence during the 1980 flood. It did, however, reproduce the depth and location of the initial degradation (downstream from Fairview St. Bridge). SLA agrees with the Phase II GDM requirement for complete lining of this reach because both observed and computed data indicate that bed degradation would occur if it was unlined. The successful reproduction of the two aforementioned flood events indicate that HEC-6 is an appropriate simulation tool for this flood event.

The Yang equation for total sediment load was used throughout the study. This procedure assumes that the amount of sediment transported is proportional to the unit stream power (the product of the average velocity and the energy slope). This equation was developed by using numerous laboratory and field data pertaining to sand size and the unit stream power is a key parameter in determing the transport capacity. As long as the physical conditions occur near the range of data from which the equation was developed, the results will be reasonable. Plate 9 (Comparison of Computed and Measured Load, Ball Road Gage) of the Phase II GDM indicates that of all the relationships available in HEC-6, the Yang equation fits the observed data the best. SLA concurrs with this choice.

A table should be included that lists the n values used for each reach for each of the various runs. The source of the value should also be listed (either from calibration or from estimation). Any other calibration parameters used in the study should also be displayed in a table. SLA concurs with the values of Manning's n used for the HEC-6 analysis in this study.

Figure 4.2 shows a plot of total sediment volume vs. exceedance probability. The curve was developed by computing the sediment inflow to the project reach for each flood hydrograph using the transport relationships from the HEC-6 analysis of the canyon reach. Using the incremental probability method indicates that the average annual sediment inflow for the project reach is 68,900 cubic yards per year. This is slightly more than the estimated sand yield from the canyon reach of 43,200 to 52,800 cubic yards per year. The deposition (31,000 yd3/year) plus sand outflow (36,000 yd3/year) for the project condition was very close to the HEC-6 inflow volume of 68,900 cubic yards. An HEC-6 analysis for existing conditions may give more insight into the impacts of the project on sand delivery to the beach. Comparing the computed results for project



-

Figure 4.2 Sediment Inflow at Weir Canyon Road Computed Using HEC-6.

conditions to the observed measurements for existing conditions may not give an accurate picture of the potential project impacts. For example, the Draft Phase I GDM for the Santa Ana River states that slightly more sand will reach the ocean under project conditions (page 58). The source of this conclusion is not known but SLA recommends that additional analysis for the sand outflow estimates would be worthwhile.

4.8 Sensitivity Analysis

A sensitivity analysis was performed to test the reliability of the HEC-6 numerical simulations. It is possible that n values could be 0.03 or higher if vegetation is allowed to grow in the channel. This case was tested and found to have only a minor effect on sediment transport behavior. Other factors tested were bed-material gradation, the formation of a sand plug at the river mouth, the effect of a significant antecedent flow before a flood event and the effect of changing the tidal boundary condition. The only factor that had a large effect on sedimentation behavior was the presence of a significant antecedent flow which resulted in a change initial bed condition. This is an important facet of the study because the presence of a dam upstream usually results in a decrease of peak flood discharges and a substantial increase in the duration of a flood. The hydraulic design was performed using the maximum amount of deposition expected during an event. This accounts for the additional freeboard necessary when there are sand deposits on the bed. SLA finds the sensitivity analysis to have been performed appropriately.

4.9 Channel Maintenance

The allowable sediment deposition gradeline is shown in Plate 14 (Upper Sediment Level). The COE estimates that the channel will reach this level about every 20 years. SLA fines this reasonable based upon the estimated average annual sediment deposition of 31,000 cubic yards per year.

V. INDEPENDENT SLA ANALYSIS

In order to check the results obtained by the Corps of Engineers, Simons, Li & Associates performed some additional analysis. A brief description follows:

5.1 Sediment Routing

The Meyer-Peter, Muller bedload equation along with a modified Einstein integration procedure was used to estimate the total sand transport capacity of the river. The river was divided into 20 reaches of similar hydraulic characteristics. Depths and velocities for the design discharge were provided by the Corps of Engineers. Table 5.1 shows the computed sediment transport results. The change in sediment transport capacity divided by the reach length and bottom width yields the rate of deposition or scour. The upper reach has a transport capacity of approximately 1 million tons per day at the design At station 745+40, near Katella Avenue, the design velocity decreases due to a change in slope. This causes the transport capacity to drop to about 650,000 tons/day. The computations indicate that deposition will occur at the design discharge for this reach (reach No. 11). Reach number 10, downstream from the Katella Avenue reach, indicates that scour will occur at the design discharge. This is because the transport capacity is greater than the amount of sediment supplied by the reach just upstream. Although the design slope of this scour reach is the same as the deposition reach just upstream, the channel width decreases so the design velocity increases. Figure 5.1 shows a plan and profile view of the river section discussed here. The channel is likely to develop a new equilibrium slope in reach number 11 after 1 to 2 feet of deposition occur. This will slow down the general scour in reach number 10. The transport capacity in the fully lined reaches (numbers 5 and 6) seems sufficiently high to prevent deposition. Reaches 1 through 4 indicate deposition. In general, SLA finds this analysis to agree with the HEC-6 results for the project condition. SLA suggests that the potential deposition in Reach 11 and the potential scour in reach 10 should be further evaluated.

TABLE 51 SEDIMENT ROUTING SUMMARY

					AVERAGE	AVERAGE	AVERAGE	TRANSPORT	BED
REACH	STATION	DESCRIPTION	Q	CHANNEL	DEPTH	VELOCITY	HIDTH	CAPACITY	CHANGE
NYBR.	NUMBERS		(CFS)	SLOPE	(FT)	(FT/SEC)	(FT)	(TON/DAY)	(FT/DAY)
1	8+38 TO 146+32	PACIFIC O	46588	8.86126	11.9	8.6	485	666136	EQUIL
2	146+32 TD 191+85	ADAMS AVE	45666	6.88664	13.5	9.3	365	642928	+1.2
3	191+85 TO 248+65		46868	6.56564	18.1	18.6	246	889936	+2.8
4	248+86 TO 273+66	S.D. FWY	46888	£.56182	11.4	11.4	246	1128324	+6.3
5	273+66 TO 398+66	EDINGER AV	- 46888	8.56266	14.8	16.3	268	4342358	CLEAN
6	398+86 TO 525+38	17TH ST	46556	6.86275	14.6	15.1	216	3447692	CLEAN
7	525+38 TO 688+7S	GON GRY BL	42666	6.66199	12.9	11.4	306	1447648	-2.6
8	688+75 TO 644+36	S ANA FLY	42666	8.56172	13.3	15.7	366	1187687	-8.5
9	644+36 TO 689+35	ORNGLID AVE	41886	6.65168	13.1	18.6	366	1657388	-1.4
18	689+35 TO 716+88	ORANGE FWY	45666	6.86194	13.3	18.2	296	912874	-4.2
11	716+88 TO 745+48	KATELLA AVE	46666	6.66194	12.7	9.1	344	655278	+6.4
12	745+48 TO 818+98	BALL ROAD	46666	8.66216	11.5	18.6	346	1168328	EQUIL
13	816+96 TO 845+96	LINCOLN AV	46666	6.66269	11.4	18.2	348	1668455	EQUIL
14	843+98 TO 891+48	GLASSELL	38666	6.66221	18.7	18.4	348	1877819	EQUIL
15	891+46 TO 914+85	ATASE RR	38866	8.66223	18.6	18.5	348	1118688	EQUIL
16	914+85 TO 977+98	RVRSIDE FHY	38886	8.86228	18.6	18.6	346	1165898	EQUIL
17	977+96 TO 1631+76	UCVIEW AVE	38866	8.68217	18.6	18.5	348	1115251	EQUIL
18	1831+78 TO 1186+3	6 IMPRL HAY	38886	8.55197	11.6	18.5	318	1633186	EQUIL
19	1186+38 TO 1156+3	8	38888	8.56171	11.9	15.2	318	968588	+2.4
28	1156+38 TO 1283+5	S WEIR CYN	38666	8.88213	11.2	18.9	318	1261188	EQUIL

NOTES:

BED CHANGE BASED ON BED HIDTH AND REACH LENGTH
"EQUIL" INDICATES THAT SEDIMENT INFLOH AND OUTFLOH IS
APPROXIMATELY BALANCED.

"CLEAN" INDICATES A FULLY LINED REACH IN WHICH NO DEPOSITION OCCURS.

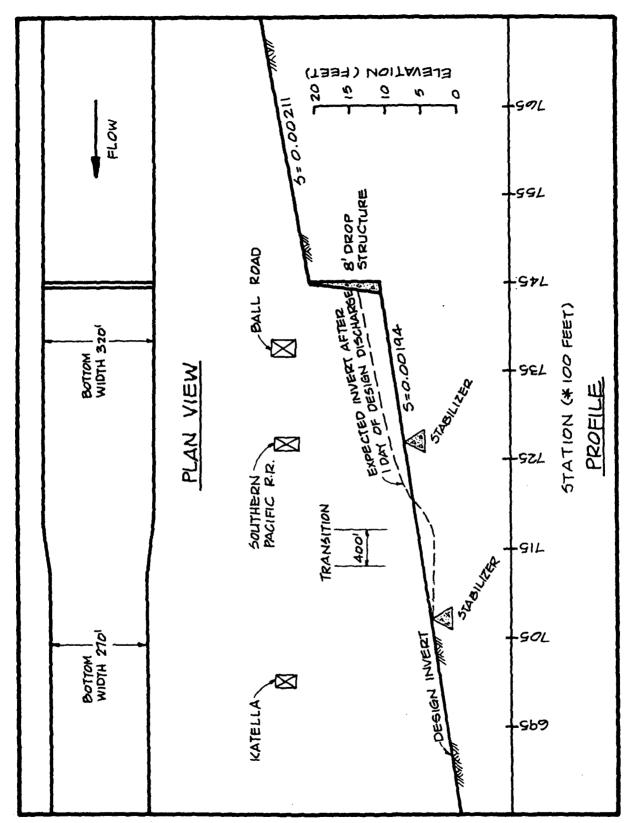


FIGURE 5.1 PLAN AND PROFILE FOR REACH 10-12

5.2 Toe Depth of Channel Lining

The following design criteria were employed to obtain the toe depth of the channel bank lining.

Situation	Toe Depth (ft)
Near Drop Structures	15
Near Stabilizers	10
Near Bridges	5 to 8
Drop Structurs Reach	5 to 8
Coastal Reach (STA 0+00 to 150+30)	8 (rip rap), 20 (cut off wall)
Golf Course Reach (STA 535+00 to 565+00)	5

In general, a conservative estimate of toe depth is the sum of degradation, general scour, local scour and a safety factor of about one foot. Degradation and general scour can be estimated by an equilibrium slope analysis or by incipient motion criteria. The latter gives the more conservative value. For the channelized section, the local embankment scour due to the angle of attack is minimized, thus the local scour can be estimated as one-half of the antidune height which is 88% of the velocity head (Sediment Transport Technology, by D.B. Simons and F. Senturk, 1977, p. 230).

The degradation and general scour were computed in Table 5 (Stable Slope) of the Phase II GDM. These computed slopes are essentially flat. If a flat slope was extended upstream from each drop or stabilizer, the maximum amount of degradation in any reach is shown in Table 5.2. The general scour is insignificant because there are no abrupt channel width restrictions. average velocity of 12 feet/sec, the local scour is about 2.2 feet. The total expected scour is shown in column 7 to Table 5.2. The design toe depth at the point of maximum degradation is shown in column 8. The difference between estimated and design toe depths is shown in column 9. Negative values indicate the toe depth is underdesigned at that location. Although the levee toe depths are, in general, adequate, some minor changes should be made. The only area of concern is the drop structure at Station 600+75 (near Garden Grove Freeway). The calculations indicate 7.9 feet of degradation which is well below the toe depth of 5 feet. SLA recommends an additional stabilizer at approximately Station 584+00 (see Figure 5.2) along with an increase of maximum levee toe depth to 7 feet in this reach. The sediment routing in Table 5.1 indicates that this is a reach of scour so the suggested design modification is appropriate. The stabilizer at Station 558+00 appears to be underdesigned but in reality since the channel uses the Riverview Golf as an overbank in this reach the design velocity is lower and thus the scour potential is small.

TABLE 5.2 LEVEE TOE DEPTH EVALUATION

(1)	(5)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			PART I TUE	PAX I PURI	SWETY	TOTAL	DESIGN	OESION
PCITATE	DESCRIPTION	ELEVATION	CHERN	LOCAL	FACTOR	SCOLE	TOE	RINS
(f7+1E8)		(FT)	SCOUR(F1)	SCOUR(FT)	(FT)	(FT)		ESTIPATE
						• • •		Carmane
	PROP STRUCTURE	313.58	N/A	NA	N/A	N/A	N/A	
	AT WELR CHANGE MED	364.56	3.56	2.2	•	6.76	18,5	3.38
	STABIL TZER	385 . 88	4.66	2.2	1	7.20	11.0	3.88
	PROP STRUCTURE	381.00	M/A	R/A	RVA	WA	WA	5.00
	NO LANGHARK)	294.06	4.38	2.2	1	7,58	16.6	2.58
	TABILIZER	209.76	4.26	2.2	1	7.48	7.6	-6.44
	NOP STRUCTURE	285.58	N/A	R/A	R/A	N/A	NA	8.88
	NO LANGHANK)	278.58	3.60	2.2	1	6.86	7.6	6.26
	TABILIZER TABILIZER	274.98	3.64	2.2	1	5.84	6.5	- 1. 54
	7451L12ER	271.26	3.76	2.2	1	6.96	8.5	-6.46
	ROP STRUCTURE	267.58	3.65	2.2	1	6.83	7.5	0.17
	AT SPERIAL NAV)	263.07	WA	N/A	N/A	N/A	N/A	5.00
1013.50 \$		258.87	3.87	2.2	1	7.87	6.5	-0.57
	ABILIZER -	255.00	3.60	2.2	1	7.86	6.5	-1.50
	ROP STRUCTURE	251.26	5,91	2.2	1	7.11	7.6	-0.11
	AT LAKEVIEW MED)	247.29	NA	R/A	N/A	NA	N/A	1.66
	ABILIZER	242.29	4,69	2.2	1	7.89	7.6	-0.09
935.85 51		257.68	4.68	2.2	1	7.98	7.6	-6,06
	OP S'AUCTURE	255.00	4.57	2.2	1	7.77	1.1	0.23
	T TUSTIN AVE)	228.43	N/A	N/A	N/A	N/A	N/A	1.00
	OP STRUCTURE	222.45	5.85	2.2	1	€.23	1.6	-0.23
	T ATESE RAIL ROAD)	217.48	WA	N/A	N/A	R/A	N/A	1.20
876.77 51		215.66	2.96	2.2	1	5, 16	5.5	5.46
B62.15 51		216.16	3,18	2.2	1	6.36	6.5	F. 26
	OP STRUCTURE	297,06 262,90	4, 18	2.2	1	7.36	7.5	1.25
	T GLASSELL)	194.66	N/A	N/A	WA	RVA	NA	P. 80
028.50 ST			3.50	2.2	1	6.78	7.5	6.36
	OP STRUCTURE	198.58 167.66	3.SE	7 2	1	6.78	7.8	2.30
	T LINCOLN AVE)	177.58	N/A	N/A	WA	N/A	N/A	8.86
794.50 ST		174.68	2.90 3.50	2.2	1	6.16	7.6	5.96
778.48 ST		171.18	3.50 3.50	2.2	1	5.78	¥.5	₩.2
761.98 ST		167.64	3.50 3.50	2.2	1	5.75	4.5	-1.21
	P STRUCTURE	164,16	N/A	2.2		6.79	7.5	8.36
	EAR BALL ROAD)	155.00	3.56	N/A	N/A	N/A	M/A	F. 86
727.60 514		151,50	3.50	2.2	1	6.78	7.8	8.34
707.00 57		147,68	3.30	2.2 2.2	1	7.10	7.6	-0 .10
\$89.65 OR:	P STRUCTURE .	144.34	N/A	R/A	1	6.54	8.5	F. 86
	AR CRINCE PLAY)	135.30	3.34	2.2	WA	N/A	M/A	8. 24
647.#I ST	WILIZER	152.00	3.70	2.2	1	6.50	6.5	5.M
644.55 DR	P STRUCTURE	126.56	WA	WA	T N/A	6.98	7.8	8.16
644.56 (AT	CHAPTAN)	120.36	3.26	2.2	1	N/A	N/A	1.20
622.50 ST/	BILIZER	117.18	3.76	2.2	i	1.4	7.6	1.60
	P STRUCTURE	113.4	R/A	N/A	N/A	6.96	7.6	8,16
	GARGEN GRY FLY)	165.44	7.98	2.2	7/4	N/A	RVA	4.00
\$67.56 \$14		90.50	2.54	2.2	1	11.16	5.0	-6.16
SSE.M STA		96.80	5.00	2.2	1	5.76	10.0	4.30
535.80 EC	IN CONCRETE CHIL	91.00	R/A	R/A	N/A	E.D AVA	5.0	-3.20
	TRANSITION	M.M	NA	R/A	N/A	N/A	N/A	1.86
405.00 DEA	DE DWEE	78.00	NA	N/A	N/A	N/A	N/A	1.20
NOTES:					·	~~	R/A	8.24
11 055104	TOE PERTY 10 42 42							

NOTES:

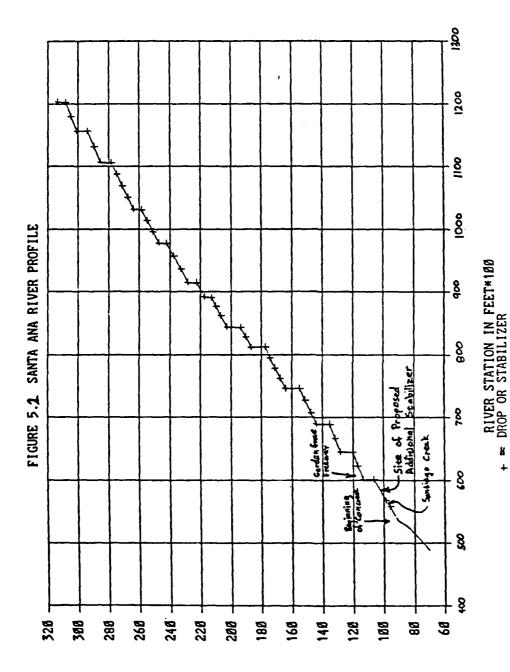
1) DESIGN TOE DEPTH IS AT POINT OF PARTIPLE GENERAL SCOUR

2) LOCAL SCOUR IS 888 OF THE VELOCITY HEAD

3) COLUMN (5): RECATIVE VALUE INDICATES UNDERDESIGN

4) MAI INDICATES THE UPSTREAM STATION OF A DROP STRUCTURE

5) GENERAL SCOUR IS COMPUTED USING A MORIZTAL (5-8.8) SLOPE



ELEVAION IN FEET

5.3 Limiting Deposit Velocity

To insure that the concrete lined channel reach remains clean, flow velocities should be higher than the limiting deposit velocity V_L . The ASCE Sedimentation Engineering Handbook (Reference 4) page 262 indicates that the deposition Froude number F_d should be at least 1.3

$$F_{d} = V_{L}/\sqrt{gD}$$
 (5.1)

Where V_L is the average channel velocity that prevents sand deposition and D is the hydraulic depth. In the completely lined reach, the typical velocity is about 22 ft/sec and the typical hydraulic depth is 9 feet. The value of F_d for these quantities is 1.29 so the channel should remain clean. SLA finds the design limiting deposit velocity to be reasonable.

5.4 Summary

The configuration of drop structures and bed stabilizers will insure a stable channel for the upper reaches. The concrete channel is of adequate length and slope to prevent scour and excessive deposition. SLA finds the COE sedimentation study to be thorough and complete, resulting in an effective design for the Lower Santa Ana River.

ADDENDUM REPORT TO THE SEDIMENT TRANSPORT ANALYSIS LOWER SANTA ANA RIVER

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1 A.	TABLE Sediment Yield for Various Floods	3
	PLATES	
1A. 2A. 3A.		

- 1. General: A detailed sediment transport analysis was conducted in support of the Phase II General Design Memorandum (GDM) using the channel configuration shown in the Phase I GDM. Subsequent to that report (referred to in text as the main report) and the independent review, the channel configuration in the concrete and channel ocean reach was changed from a rectangular channel to a trapezoidal channel. As a result, a sediment transport analysis using HEC-6 was deemed necessary to predict channel bed profiles for the design flood and to determine the average annual channel deposition and sand outflow. This report describes the sediment transport analysis and the results for the trapezoidal channel design. This report is appended as part of the sediment transport main report found herein, since it covers only the changes to the Phase II design.
- 2. Revised Channel Features: The redesign of the channel extends from the Pacific Ocean upstream to and including the channel through the Riverview Golf Course. The differences in channel design from the Phase I GDM configuration consist of: changing to a trapezoidal channel from the river mouth upstream to Station 150+00 and in the reach from Station 273+00 upstream to Station 600+73, with base widths varying from 160 feet to 410 feet and side slopes of 1 vertical on 2 horizontal; lowering the channel invert in the reach from Station 460+00 upstream to just upstream of the confluence with Santiago Creek; adding a drop structure and invert stabilizer in the golf course reach; and lowering the crest of the drop stucture located at Station 689+85. A detailed discussion of the project features is presented in the hydraulic design report.
- 3. Study Approach: The impact to the results shown in the main report are the HEC-6 results which established the design deposition slope, design of the levee toe depths, and the determination of the average annual deposition and sand outflow. Sediment transport in the improved channel reach, including the revised trapezoidal channel, was simulated for the design flood and for the 10-, 25-, 50-, and 100-year floods. Two different inflowing sediment load curves were used for the design flow simulation to bracket the bed changes, that is, deposition in the case of high sediment inflow and scour in the case of reduced sediment inflow. The analysis with HEC-6 was streamlined to use only those program parameters that were sensitive to the changes in bed elevation during the design event. The results from the HEC-6 sensitivity analysis indicate the that bed changes were sensitive to the initial channel geometric condition and the antecendent flow hydrograph. To provide a worse case scenerio for the initial geometric condition the channel invert data in HEC-6 for the design flood simulation was adjusted to the upper grade limit established in the main report (see pl. 14 main report). For the design flood scour analysis and the more frequent flood analyses, the channel invert data was set at the design invert (see pl. 3A). In the design flood analysis conducted in the main report, the design hydrograph was combined with an antecedent flow hydrograph of 5,000 cfs for 38 days. The purpose was to represent a worse case flood scenerio. This combined hydrograph, however, was overly conservative and would not be representative of the project release schedule for Prado Dam. To account for the possibility of a flood preceding the design flood, the 1969 flood, which was a major flood event, was selected. The 1969 flood was routed through Prado Dam to provide the project condition antecendent flood hydrograph. The 1969 flood was then followed by the design flood to represent a worse case flood scenerio.

Other program parameters discussed are the Manning's "n" value, the tidal hydrograph, and the bed material gradation. The Manning's coefficient "n" was set in accordance with those values used in the original analysis, n=0.02 in the channel ocean reach, n=0.015 in the concrete channel reach, n=0.025 for the drop structure reach, and checked for sensitivity by assigning a high "n" value of 0.03 in all reaches. The HEC-6 analysis using a tidal hydrograph or an increase in bed material gradation was not conducted because both were found to be insensitive to the channel bed deposition at the peak of the design flood. This study considered only the detailed sediment routing analysis using HEC-6 for which the results are presented in subsequent paragraphs.

4. Results of the HEC-6 Analysis

4.1 Design Flood: The HEC-6 analysis was conducted by initially setting the streambed at the upper grade limit, and computing bed changes using the combined hydrograph of the 1969 flood followed by the design flood. The results of the HEC-6 computations of the streambed profile for the combination antecedent flow and design flood are reasonable in the trend prediction. The bed change results were depicted at the peak of the design flood hydrograph. The maximum water surface elevation in the channel, including the bed change, also occurred at the peak of the design flood hydrograph. The results are similar to the results found with the Phase I channel configuration. However, the location and quantity of the depositional bed change for the case of high sediment inflow in both the channel ocean reach and the downstream portion of the concrete reach were slightly different. To represent the general magnitude of deposition, a deposition design profile was developed that encompassed the bed changes. The deposition design profile starts at Station 272+60 at elevation 23.0 feet NGVD, extends downstream at a slope of 0.001072 to Station 56+35. At Station 56+35, the deposition profile breaks slope to 0.00035 and continues downstream to Station 36+35. At Station 36+35, the deposition profile again breaks slope to 0.001478 and continues downstream to the ocean outlet at river mouth Station 8+55 at elevation -5.0 feet NGVD. This deposition design profile was also analyzed for sensitivity by applying a higher "n" value of 0.03 in all reaches in the HEC-6 model. The results indicated that the depositional bed change was below the depositional design profile at the peak of the design flood. No significant bed change occurred in the concrete reach upstream of Station 272+60 to the concrete inlet and in the revised channel in the golf course reach. The results obtained in the drop structure reach, including the lowered drop structure at Station 689+85, were the same as shown in the main report (see pl. 11). Plates 2A and 3A display the design streambed profiles with and without sedimentation, respectively, over the entire reach from the Pacific Ocean to the improved channel inlet upstream of Weir Canyon Road bridge. Using the combination of the deposition design profile in the reaches of aggradation with the design invert slopes in the other reaches, the design water surface profile was computed and the levee heights were determined as described in the hydraulic design report.

The HEC-6 analysis for the other design case of levee toe depth was performed for just the trapezoidal channel downstream of the concrete channel inlet. The HEC-6 analysis was conducted by setting the inflowing sediment load to zero at the concrete channel inlet. The HEC-6 results for general degradation in the channel ocean reach were slightly greater that the results

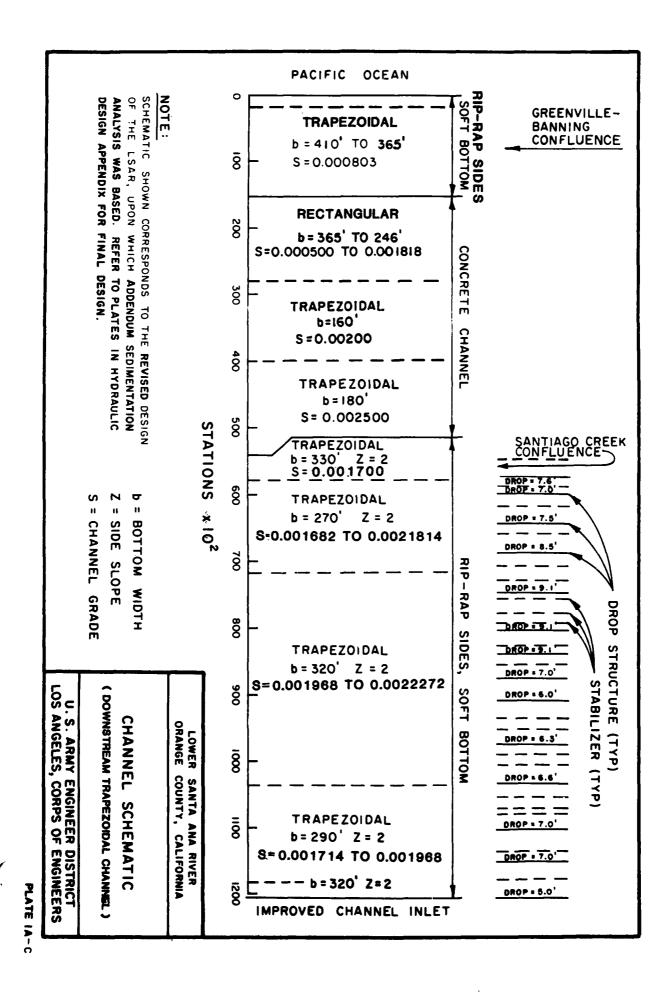
of the Phase I configuration. The maximum general degradation was about 9 feet below the design invert in the portion of the channel ocean reach just downstream of the concrete channel. Based on these results, the levee toe depths were increased from 6 feet to a minumum of 10 feet below the design invert for the entire length of the earth bottom channel ocean reach. The levee toe analysis and results for the drop structure reach can be found in the main report.

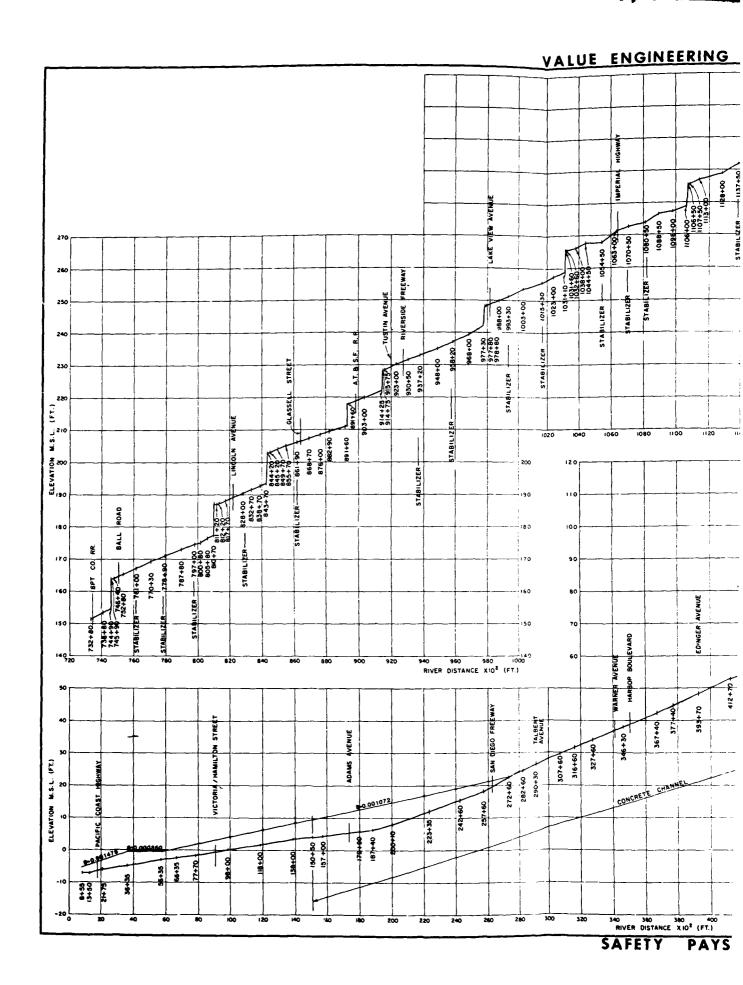
4.2 Average Annual Deposition and Sand Outflow: The average annual deposition and sand outflow was analyzed for the trapezoidal channel using the incremental probability method. The method was applied in the HEC-6 analysis for the design flood, 100-, 50-, 25-, and 10-year floods to determine the volume of deposition and sand outflow for each flood. Table 1A summarizes the deposition and sand outflow quantities.

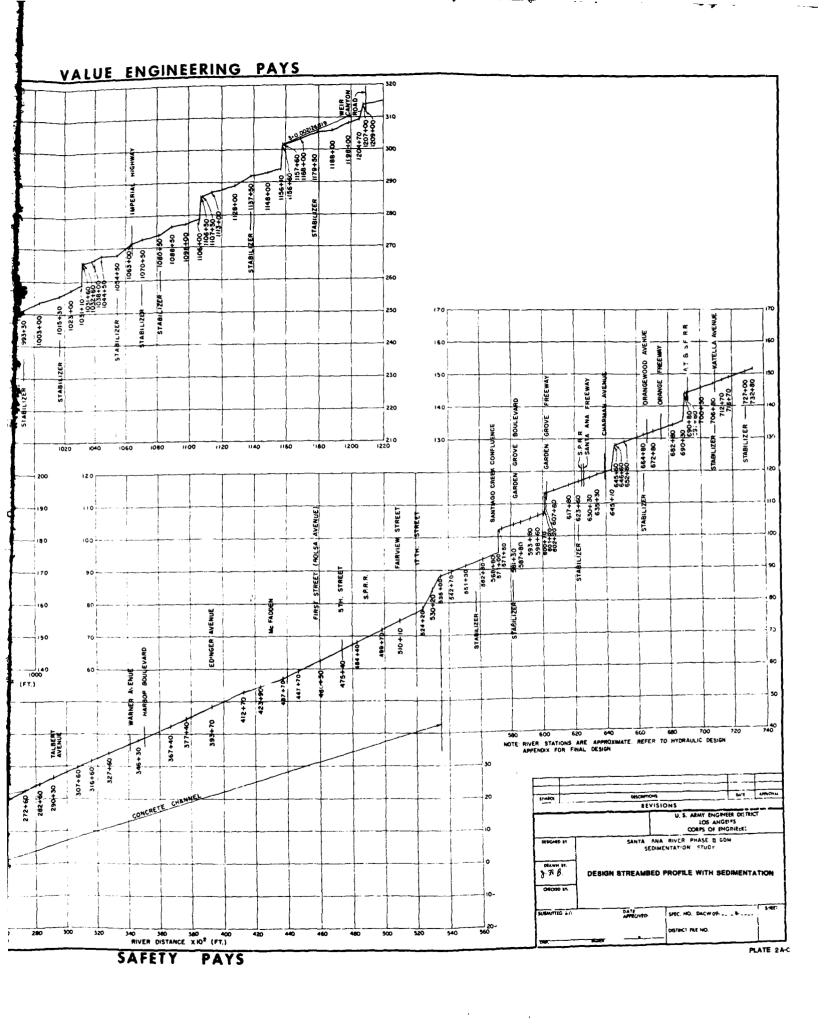
Table 1A. Sediment Yield for Various Flood Downstream Trapezoidal Channel.

Flood (year)	Sediment Deposition (x1000 yd ³)	Sand Outflow (x1000 yd ³)
170	1,590	2,222
100	762	441
50	447	244
25	234	141
10	79	14
Annual	37	30

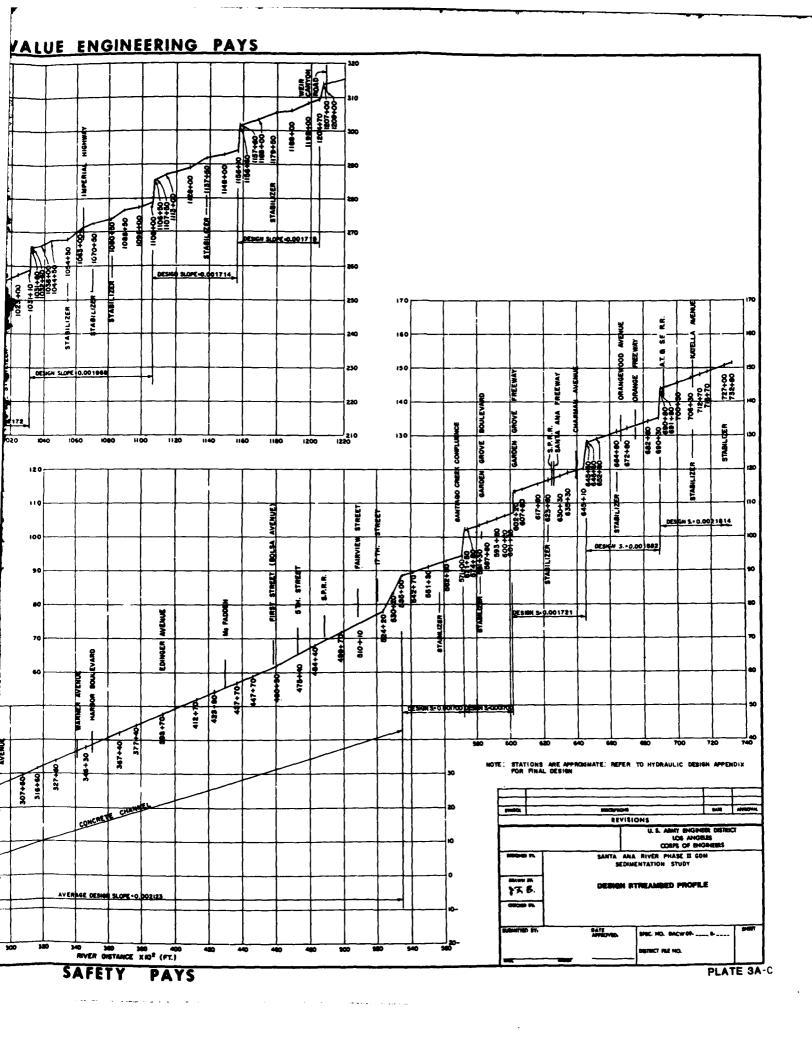
The results indicate an increase in the average annual deposition from 31,000 cubic yards for the Phase I channel configuration to 37,000 cubic yards for the trapezoidal channel. The results also show a decrease in the average sand outflow from 36,000 to 30,000 cubic yards. Using the upper grade limit with a corresponding volume of 660,000 cubic yards, sediment will have to be removed from the downstream channel reach on an average of once every 18 years. It should be noted that because the annual volume of water/sediment can vary significantly, the average annual deposition rate and maintenance are considered long term averages. No sediment removal maintenance is anticipated in the concrete reach upstream of Station 223+35 and in the drop structure reach, including the golf course.







SAFETY PAYS



RECREATION

RECREATION APPENDIX to the PHASE II GENERAL DESIGN MEMORANDUM SANTA ANA RIVER MAINSTEM FEATURE

Counties of Orange and Riverside Cities of Newport Beach and Huntington Beach, California

U.S. ARMY ENGINEERING DISTRICT LOS ANGELES, CALIFORNIA

APPENDIX D

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I. INTRODUCTION

1-01 The following text details the background and authority, purpose, scope, and basic assumptions of this appendix.

Background and Authority

- 1-02 A "Review Report for Flood Control, Santa Ana River, Mainstem", dated December 1975, was prepared by the Los Angeles District, Corps of Engineers. It presented a plan of trails and other recreation facilities to be developed with the proposed Santa Ana River flood control project.
- 1-03 Subsequent to the Review Report was the preparation of the Phase I General Design Memorandum. The purpose of the Phase I General Design Memorandum was to examine the 1975 Review Report and to affirm the validity of the previous plan in light of current conditions and criteria, or to re-formulate the plan as required by such conditions and criteria. Nearly 5 years had elapsed since the Survey Report study conclusions had been made.
- 1-04 The initial study of recreation potential for the Santa Ana River Mainstem, Santiago Creek, and Oak Street Drain was authorized by the Federal Water Project Act of 1965, and as required by the Federal Water Project Recreation Act of 1965, Public Law 89-72, whereby full consideration must be given to the opportunities for public outdoor recreation afforded by the water resource development project. The Water Resource Development Act of 1976, Section 109, authorized the Phase I advanced engineering and design for the Santa Ana River Project. The Phase I General Design Memorandum, including recreation as a project purpose was submitted in September 1980, and approved in January 1982. The recommended plan for recreation development proposed for the Santa Ana River Mainstem and Santiago Creek was found to be economically justified and desirable. Authorization for construction of the Santa Ana River Mainstem Project, including Santiago Creek, was contained in the Water Resource Development Act of 1986.

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Purpose

1-05 The purpose of this appendix is to identify the recreational and environmental resources along the mainstem of the Santa Ana River Flood Control Project, present public use projections, and show the level of recreational development appropriate to accommodate the anticipated use. The appendix will also serve as a general guide to the orderly and coordinated development and management of the environmental resources of the project lands. Cost estimates for the proposed recreation facilities are provided. The Santa Ana River Flood Control project has been authorized as a local protection project and as a result no Master Plan will be prepared. The information contained in the Phase II General Design Memorandum is considered sufficient for the preparation of plans and specifications.

Scope

1-06 The coverage of this appendix is limited to specific information required to insure an understanding of the basic recreational and environmental resources inherent within the Mainstem Feature of the Santa Ana River Flood Control Project. The information provided consists of the demographic characteristics of the project area; topographical, geological and ecological features; a narrative description of existing and proposed recreational facilities, market area analysis, projected development costs, and coordination activities involving other agencies. The intent of this appendix is to present a plan for the public use of project lands that is compatible with the preservation of existing environmental resources.

Basic Assumptions

1-07 The Corps participation along the mainstem of the Santa Ana River for recreation improvements is limited to lands acquired for flood control purposes. Lands outside the flood control rights-of-way may be acquired for health, safety, and public access on a cost shared basis if required. Flood control improvements by the Corps consist of channel improvements between the Pacific Ocean and Weir Canyon Road, construction of a levee within the canyon at Green River Golf Course, and an inlet structure just below Route 71.

1-08 The recreation plan for the Santa Ana Mainstem was developed in conjunction with the Resource Use Master Plan at Prado Dam and the Santiago Creek recreation plan in order to maintain continuity of the Mainstem recreation system. All features will be designed in an efficient and economic manner to reduce operation and maintenance costs.

1-09 The Environmental Management Agency (EMA) of the County of Orange is implementing a master plan of countywide bikeways. This plan was originally adopted by the Orange County Board of Supervisors on September 29, 1971 as a component of the recreation element of Orange

County's General Plan, and on September 23, 1980 ratified it as a component of the transportation element of the general plan. In conjunction with this plan is an adopted county wide master plan for riding and hiking trails, dated September 1984. The county of Riverside has also developed a bike and equestrian trail network within the county boundary. Local city bicycle and equestrian routes would also make connection to the regional trail in order to establish community links with the 30-mile system. The proposed Santiago Creek bicycle trail, located within the vicinity of River View Golf Course, will also provide an additional important segment or link to the overall regional trail network.

- 1-10 Much of the existing trail system, including the bridge underpasses, was partially funded under the Land and Water Conservation Fund Act of 1965. This act requires that any removed facilities be replaced with ones of equal value and utility (Section 5F of Public Law (88-579). With the proposed flood control improvements, most of the existing Lower Santa Ana River trails and bridge underpasses will be removed due to channel widening and rebuilding. They will be replaced as part of the flood control project. Their replacement will be treated as a relocation cost. Under current cost-sharing policies, relocation is 100 percent a local cost.
- 1-11 For the purpose of this report, 28.5 miles of Lower Santa Ana River trail is considered a relocation. Improvements to the remaining 3.5 miles of trails is discussed in sections 5-03 through 5-06.
- 1-12 Development of previously agricultural and open space lands has dramatically increased the population of the area adjacent to the flood control project. The increased urbanization has produced an urgent need for additional recreation facilities.

II. DESCRIPTION OF PROJECT AREA

2-01 A comprehensive description of the project area is included in the Environmental Impact Statement. Project area features covered in this section are pertinent only to the formulation of the recreation plan.

2-02 Below Prado Dam, the Santa Ana River enters Orange County via the Santa Ana Canyon, flowing in a southwesterly direction. It follows a natural meandering course for approximately 7 miles to Weir Canyon Road. Beginning here, the river becomes channelized. Continuing on its way to the ocean, from Imperial Highway to Katella Avenue, the river flows through a series of water spreading basins, controlled by the Orange County Water District. Now heading in a south-southwesterly direction, it crosses the coastal plain in Orange County to the Pacific Ocean at Huntington Beach. A salt water marsh is located on the east side of the channel at the river's mouth.

Biological and Ecological Features and Resources

2-03 Santa Ana Canyon supports a relatively high value natural riparian habitat for over 200 species of plant and animal life. These include herons, hawks, quail, mice, racoons, coyotes and gray fox. Vegetation along the river varies considerably. In areas downstream of the canyon little vegetation exists, especially near the coast. The mouth of the Santa Ana River is ecologically sensitive and therefore has been eliminated from extensive recreation planning. Within Orange County, the output from sand and gravel mining operations along the river was at one time the second highest in the State. Other minerals have been found in the canyon but not in quantities sufficient to allow for profitable operations. The names of Coal Canyon and Gypsum Canyon, which enter the Santa Ana Canyon, are indicators of earlier mining operations.

Climate

2-04 The climate is mediterranean (mild winters and hot summers). Dry, seasonal winds called the "Santa Anas," come from the desert areas to the northeast and east. Annual precipitation averages 12 inches per year, with 92 percent of it falling between November and April.

2-05 Climate conditions in the immediate coastal area are directly influenced by the surrounding marine air conditions which produce moderate to hot summers and mild winters. There is moderate to heavy fog occurring primarily from mid-December to March. Low clouds are mainly restricted to the late afternoon to mid-mornings.

Topography

2-06 The Lower Santa Ana River basin is relatively flat with a gradient suited for both a bicycle and equestrian trail. Elevations vary from -6 feet near the mouth to +450 feet at the upstream drop structure (sta. 1607+50), a distance of 30 river miles. Surrounding the Santa Ana Canyon are mountain ranges separated by an intermediate valley with the low lying Chino Hills to the north and the Santa Ana Mountains to the south. The remaining route of the river is through the generally level coastal plain.

Geology and Soil Characteristics

2-07 The coastal plain, a physiographic and structural basin, contains a thick sequence (up to 30,000 feet) of chiefly marine and nonmarine clastic sedimentary rocks overlying igneous and metamorphic basement rocks. These sediments derived from surrounding highland areas, were deposited in the ever deepening basin; an ongoing process which during the most recent geologic time has resulted in the accumulation of up to several hundred feet of alluvium in modern stream channels and associated floodplain and alluvial fans, and beaches.

Access and Circulation

2-08 The urbanized section of the Lower Santa Ana River is crossed by many arterial roads as well as one major highway (Pacific Coast Highway) and five freeways (Garden Grove, Riverside, Santa Ana, Orange, and San Diego). Access to the bicycle and equestrian trails would be provided at all street crossings.

2-09 Due to the dense urbanization of the area between Weir Canyon Road and the Pacific Coast Highway arterial roads are subject to extremely heavy traffic conditions that discourage their use by most bikers. The bike and equestrian trails provide a safe transporation corridor through this region and encourage increased use of the Santa Ana River Regional Trail System. Completion of both trails in the Santa Ana Canyon will maximize trail usage by providing connecting links to other inter-county and city trail systems.

Operational Limitations

- 2-10 Disruption to trail use will occur during reconstruction of the river channel, bridges, and bridge ramp undercrossings which may effectively close the trails for years. During construction periods, temporary routes would need to be provided to assure the maximum interim use possible of the public trail facilities.
- 2-11 The proposed bicycle and equestrian trails at Green River Golf Course cross underneath the Santa Fe Railroad bridge. An easement from the railroad must be acquired in order to allow trail access through this area. To date the railroad, anticipates no problems with granting this access, pending review of final design. In the event the easement is denied, undercrossings of both trails would need to be re-studied for development of alternative routes.
- 2-12 Storm conditions could produce high velocity flows within the river. Equestrian use of the riverbed wet crossings during these conditions will be interrupted periodically. Streamflow during non-storm conditions are anticipated to range from 200 to 300 cfs.

III. RECREATION MARKET AREA

Boundaries/Region Served

3-01 The recreation market area for the Lower Santa Ana River Flood Control Project consists of those residents located within 5 miles of the river's centerline, from the Orange County border to the Pacific Ocean. This area and distance were chosen because 5 miles is considered to be a reasonable travel distance for use of a regional trail. It is anticipated that a minimum of 80 percent of the day use of the bike trail would originate within this zone. Additional usage from outside the market area is also anticipated because the trail makes efficient use of the channel right-of-way and encourages alternate transportation modes within the urban area, it provides direct access to major recreational areas, and serves as a link to the trail corridor extending up Santiago Creek. Because the Corps development would be an integral part of the 30-mile proposed trail system, market area and demand have been analyzed for the entire Lower Santa Ana River trail corridor.

Socio-Economic Characteristics

3-02 Users of the trail system will come primarily from portions of 12 Orange County cities that lie within the lower basin area. Those are Yorba Linda, Placentia, Fullerton, Villa Park, Anaheim, Orange, Garden Grove, Santa Ana, Fountain Valley, Huntington Beach, Costa Mesa, and Newport Beach. Over 1,000,000 people reside or work within this area. Projected populations for the Lower Santa Ana River market area are snown in the table below. The market area for Santiago Creek overlaps portions of the Lower Santa Ana River market area and therefore has been netted out of the 5-mile service area.

Table D-1. Projected Population in Lower Santa Ana Market Area, 1980-2000

1980	1985	1990	1995	2000
931,394	1,004,696	1,055,731	1,109,599	1,138,710

Based on information provided by Southern California Association of Governments and Orange County Preferred Projections 1985 (Orange County Department of Administration - Forecast and Analysis Center).

According to the U.S. Bureau of Census it estimated the uncounted population to be about 2.5 percent. The figures reflected in this appendix do not account for these persons.

3-03 The lower basin is highly urbanized with mostly residential housing. The Santa Ana Canyon area located downstream of Prado Dam to Wier Canyon Road, is the only major area of undeveloped land in the lower basin. Population growth has slowed because developable land within the basin has largely been used up. Because the Santa Ana Canyon River Basin overall is thriving economically, it is a highly desirable place to live. Employment growth in the basin has continued strong since the 1975 Survey Report, but has not increased at as high a rate as the upper basin area. Income levels in the lower basin remain higher, though, than those in the upper basin. Manufacturing, trade, and service continue to dominate basin employment. Pressure to develop remaining open space remains high in the lower basin, particularly in the Santa Ana Canyon area. The percentage of athletically oriented adults and children is higher than average.

Inventory of Existing and Proposed Facilities

3-04 Currently existing trail development in the lower reach of the Santa Ana River includes 26 miles of bicycle and equestrian trails extending from the Pacific Ocean up to Gypsum Canyon Road. Additionally, in the Santa Ana Canyon, between Gypsum Canyon Road in Featherly Regional Park and the Green River Golf Course entrance is 2.5 miles of bicycle and equestrian trails. The existing and proposed facilities are shown on plates 1 through 5.

3-05 The existing trails include underpasses at all tridges and access to trails at all street crossings. In addition, access is available from three adjoining Orange County regional parks—-Centennial, Yorba, and Featherly, plus two local parks, located, respectively, in Santa Ana and Huntington Beach.

- 3-06 The bike trail currently has four bridges crossing the trail over the river, with three additional bridges proposed. The equestrian trail has one proposed bridge crossing and four proposed wet crossings (pls. 1 and 2). The four wet crossings are located in the canyon area where the river is not channelized. There are private horse rental and boarding stables adjacent to the equestrian trail at several locations in the city of Anaheim and Santa Ana canyon.
- 3-07 Eight trail rest stops currently exist along the entire channel reach. The local cost sharing agency has no plans to develop additional sites at this time. Because the lower 28.5 miles of trail system, from Featherly Regional Park to the Pacific Ocean, is considered strictly replacement, any improvements to the trail within this reach will not be eligible for cost sharing and therefore must be funded entirely by the local agency.
- 3-08 In order for both trails to run continuously along the entire system all proposed new bridge construction and replacement must be completed.
- 3-09 Future development of bicycle and equestrian trails below Prado Dam would consist of completing the remaining trails planned under the countywide master plan for Orange County and local city wide plans to establish community links with the Santa Ana River regional trail system. For example, the city of Yorba Linda has 12 miles of equestrian and hiking trails that could tie into the Santa Ana River trail.
- 3-10 The most significant recreation facility imposing major impacts on the lower river is the Chino Hills State Park development, located directly west of Prado Basin (pl. 2). The proposed system of trails, campsites, picnic areas and open space will form a land use interface with adjacent recreational areas including the Santa Ana River trails. The State Department of Parks and Recreation estimates that final development of the recreation facilities will include 42 miles of equestrian trails and 18 miles of bicycle trails.
- 3-11 Demand for recreational activities proposed for the Lower Santa Ana River is based upon the application of per capita participation rates to the market area population 5 years of age and older. The recreation market area had a trail demand of over 11.3 million activity days during peak summer months in 1985 and will have over 22.8 million activity days during peak summer months in the year 2000. This is based upon summer season per capita particiation rates and growth factors provided in the Orange County Recreation Needs and Regional Park Study (table D-2).

Table D-2. Potential Trails Demand for Lower Santa Ana River Market Area For Summer Season 1, 1985 and 2000.

	Per Capita Participation Rates ²		Market Area	
	1985	2000	1985	2000
Population Five Years of Age & Over (thousands) ³	NA	NA	894,179	1,024,839
Activities Bicycling Horseback Riding	12.15 .52	21.50 	10,864,274 464,973	22,034,038 50,616
Total Trails Demand			11,329,247	22,884,654

^{1.} Memorial Day through Labor Day.

^{2.} For Population Five Years of Age and Older.

^{3. 89%} of Total Population in 1985, 90% in 2000.

³⁻¹² The Lower Santa Ana River trails could accommodate approximately .4 percent of ultimate trails demand in 1990 and .2 percent of ultimate demand in 2000. This is based upon a maximum peak season use of 55,242 shown in the following table D-3.

Table D-3. Maximum Use During Peak Summer Season for Lower Santa Ana River Trail (From Prado Basin to the Pacific Ocean).

TOTAL USE DUR- ING PEAK SEASON	36,828 18,414 55,242
# OF = PEAK MONTHS IN SUMMER SEASON	3.3
TOTAL x USE DUR- ING PEAK MONTH	11,160
% OF = PEAK USE ON WEEK-	5.
TOTAL + WEEK- END USE IN PEAK MONTH	5,580
WEEK- = END DAYS IN PEAK MONTH	6
# OF x MAX DAILY RECRE- ATION DAYS	310
carion Ratio	
TURN- 3	
units x	31
DENSITY x UNITS x TURN-	20 10
ACTIVITY	bicycling horseback riding

IV. RESOURCE USE OBJECTIVES

Definition

4-01 Resource use objectives state the scope and intent of planning within which the proposed plan of physical development was formulated and outline the plan for optimum use of project lands and resources.

4-02 The upper portion of the lower river reach starts in the Santa Ana Canyon, where Green River Golf Course, owned and operated privately, is bisected by the river's natural course. This area provides an outstanding example of a natural riparian community. The Santa Ana Canyon is one of the few remaining open space habitats in the area. Below this reach of the river, starting just upstream of Weir Canyon Road, the river becomes channelized for 23 miles to the Pacific Ocean. The river is completely contained within channel levees to protect the densely populated, broad, gently shaped coastal plain of Orange County. There are several spreading basins in this 23-mile reach.

Basic Objectives

- 4-03 The basic objectives are outlined below:
 - a. To provide a high quality experience for bicycling, hiking and equestrian riding opportunities through a well-planned trail system. Those sections within the flood control right-of-way not stipulated for channelization or as prime floodways are excellent resource areas for trail development. Esthetic treatment, provision for convenient comfort facilities, multi-seasons use capability and convenient public access are necessary for a quality experience.
 - b. To locate trails and ancillary facilities with respect to resources sensitive to human use.

- c. To interpret the project resources to the public. Public education of the value of the Lower Santa Ana River's natural ecological systems would be increased through personal interactions and experiences with the natural environment.
- d. To limit incompatible development. Trails would be built in a manner which is in harmony with surrounding and abutting uses. Landscaping would provide shade and screening. General esthetic treatments would benefit both the trail users and abutting land users. Structures and signage should be consistent with the surrounding environment.

Resource Use Objectives

4-04 Objective 1: To provide a scenic, safe, high quality bicycle and equestrian trail that would function as an integral component of the 32-mile Santa Ana River Regional Bicycle Trail.

(Discussion) The analysis of pertinent factors indicates there exists a high demand for regional bicycle and equestrian trail development. No additional Class I trails are currently planned within the market area that would compete with the 32-mile Lower Santa Ana River Regional trail. The County of Orange has indicated that development of a county-wide bikeway system would increase the use of regional recreation sites within or on the edge of the metropolitan zone. This project, with its outstanding scenic qualities within the canyon and its central location, provides a key segment in this integrated system. The County of Orange has funded construction of other downstream portions of this trail system with the expectation of Corps involvement. Increased urbanization of the lands surrounding the flood control project would provide a high user rate for the bicycle trail. With the trails gradient suited for bicycle users, a more enjoyable experience will be provided.

4-05 Objective 2: To develop an erosion control and esthetic treatment plan to complement the flood control project.

(Discussion) Construction of the flood control channel would disrupt the surrounding natural environment. Vegetation provided for erosion control and esthetic treatment should be compatible with the existing native vegetation located within immediate surroundings, thereby maintaining the identity and character of that particular area in addition to providing for screening, shading and visual enhancment. Certain non-native plant material noted for its color, foliage and/or flower could be introduced along the lower reach provided it is compatible with the plant communities being established.

V. RECOMMENDED PLAN OF PHYSICAL DEVELOPMENT

General

5-01 The availability of prime vacant land in the middle of a heavily urbanized area, in conjunction with the need to provide safe bicycling and equestrian trails for recreation and transportation, has provided the impetus for providing recreation facilities as an integral element of the Lower Santa Ana River Flood Control Project. As a result of previously unrestrained commercial and residential growth in the northern Orange County area, lands available for open space, and recreation are rapidly decreasing. Lands adjacent to and made available for the single-purpose use of flood control provide a logical choice for multipurpose recreation enhancement. The optimum use of flood control lands is based on the consideration of the open space potential of such lands. This consideration establishes the interrelationship between flood control and recreation use.

5-02 Corps participation in the Lower Santa Ana River trail would be cost shared development of approximately 3.5 miles of paved bike trail and 4.0 miles of graded equestrian trail, located entirely in the Santa Ana Canyon area. Beginning at Green River Golf Course, both trails would connect to the 28.5 miles of replaced downstream trails and would both terminate just below Route 71 at river station number 1607+50 (see pl. 2).

Proposed Trail System

5-03 The proposed flood control project in the Green River Golf Course area provides for a levee on the south side of the river. Starting at the Santa Fe railroad bridge, it extends downstream for approximately 2600 feet, ending just upstream of the Green River Golf Course entrance bridge. The 12-foot-wide asphalt bike trail would run along the top of this levee after crossing over the bridge road. It then crosses under the AT&SF railroad bridge and turns west over the river across a new

bicycle bridge. Once across, the trail would then run parallel with the railroad tracks on a separate lower graded surface, approximately 1800 feet, then follows the Santa Ana River Regional Interceptor (SARI) right-of-way to its connection point with trails going into Prado Basin (sta. 1607+50) - (see pl. 2). Support facilities such as restrooms and drinking fountains have not been proposed for development along this reach of trail system because utility connections are not available, and the remote location would encourage vandalism resulting in excessive operation and maintenance costs. The County of Riverside is currently proceeding with a request for a 30-foot trail easement from the Santa Ana Watershed Project Authority (SAWPA) which has controlling authority over the right-of-way.

5-04 The railroad tracks are not within the floodplain area, as the trails are, but are located on a raised graded surface, primarily to separate the tracks for safety and clear lines of sight.

5-05 The proposed equestrian trail begins further downstream across the river from the eastern most boundary of Featherly Regional Park, approximately at station 1429+25. A wet crossing from Featherly Park picks up the new section of trail on the north river bank From this point the trail runs parallel to and between the Santa Fe railroad tracks and the Green River Golf Course until it reaches the river (see pl. 2). The trail then swings under the railroad bridge, to the left and continues along size the bicycle trail from this point on until river station 1607+50, where the trails into Prado Basin will connect.

5-06 Once completed, the entire 32-mile system of trails would provide direct off road access to major recreational facilities at the Pacific Ocean and proposed facilities within Prado Basin and Chino Hills State Park. The trail is a significant element in a comprehensive recreation plan, consisting of a mountains-to-sea trail corridor, extending from the Pacific Ocean to the San Bernardino National Forest, and tying into the Pacific National Trail as well as various local and community parks adjacent to the trail corridor. The trail would support national and state goals to reduce energy consumption by helping to minimize dependence on motor vehicle transportation to recreation areas.

VI. COORDINATION WITH OTHER AGENCIES

6-01 The following Federal, State, County, and local agencies have been contacted. The roles they played in the planning and coordination of the proposed plan are briefly summarized.

Federal Agencies

6-02 There was no involvement with other Federal agencies in the development of the recreation plan for the Lower Santa Ana River.

State Agencies

6-03 California State Parks and Recreation Department was contacted for information regarding the proposed Chino Hills State Park and general recreation planning data for southern California. The California Transportation Department (CALTRANS) was contacted regarding the design and construction schedule of the Pacific Coast Highway bridge at the mouth of the Santa Ana River.

Count, Agencies

6-04 The County of Orange, Department of Parks and Recreation, Transportation Planning Division and the Department of Administration-Forecast and Analysi. Center. Contacts were made concerning local planning in regard to replaced portions of the of downstream bicycle and equestrian trails, development of the recommended plan for trails through Santa Ana Canyon, and demographic information.

6-05 County of Riverside, Parks Department. This agency was contacted development of the recommended plan for recreation trails through Santa Ana Canyon.

Local Groups

6-06 Cities of Newport Beach and Huntington Beach. Contact was made with these agencies concerning the design of the bicycle trail at the mouth of the Santa Ana River.

6-07 Huntington Beach Wetlands Conservancy. Coordination was made with this agency concerning local planning and design of the bicycle trail at the mouth of the Santa Ana River.

Special Problems

6-08 Disruption of trail use will occur during reconstruction of the river channel, bridges, and bridge ramp underpasses. This could effectively close the already existing portions of trail for years. However, according to County policy, the lead agency responsible for the project at hand, would be required to undertake measures to provide bypass routes in order to assure maximum interim use of the public trail facility.

6-09 In the event that the Santa Fe Railroad does not process the easement request for access underneath their railroad trestle, both the bicycle and equestrian trails would need to be redesigned in order to access trails going into Prado Dam.

6-10 The existing recreation trails are considered as a utility, and their replacement will be treated as a relocation to be funded by the County of Orange. Portions of the existing trails have been funded under the Land and Water Conservation Fund Act. The County of Orange, Environmental Management Agency, has assumed the responsibility of determining what clearances or approvals are required in connection with this funding, or any other grant funding, and initiating the appropriate action to maintain compliance with all pre-existing contractural agreements entered into by the County of Orange and other State and Federal Agencies.

VII. MANAGEMENT AND COST SHARING

7-01 The operation and management of all recreation facilities so constructed under this authority will be the responsibility of the local cost sharing agency.

7-02 Public Law 78-534, The Flood Control Act of 1944, Section 4, authorizes the Corps of Engineers, to construct, operate and maintain public recreational facilities at water resource development projects, and to permit local interests to operate and maintain such facilities. Public Law 89-72, The Federal Water Project Recreation Act of 1965, provides a basis for the development of recreation facilities on a cost shared 50-50 basis between a local sponsoring agency and the Federal Government. Proposed recreation facilities are consistent with recreation policy regulation ER 1165-2-400, and all subsequent policy directives. The paved top of levee doubling as maintenance and access roads will be charged to project cost only. The proposed paving of the bicycle trail that is off levee, is not a feature of the flood control project and will be charged to the recreation account. The 28.5 miles of existing trails will be treated as a utility and relocated at 100 percent local expense.

VIII. ENVIRONMENTAL QUALITY

8-01 The flood control project is expected to have very minimal impact on the riparian habitat located directly adjacent to the Santa Ana River as it runs within Santa Ana Canyon, and no impact on the surrounding grasslands to the north of the river. A levee along the east river embankment will be constructed to protect an existing mobile home park (pl. 2), and the bicycle trail will be located on top of this levee. No additional landscaping for recreation is proposed beyond that required for erosion control and bank stabilization and thus no landscaping costs are presented in table D-4, on page D-IX-2, volume 3, appendix D.

8-02 The bicycle trail will pass under the existing Santa Fe railroad bridge on the east bank of the Santa Ana River, and will cross to the west bank on a new bridge to be constructed directly upstream from the railroad bridge (pl. 2). The equestrian trail will pass under the railroad bridge on the west bank and merge with the bicycle trail immediately upstream of the railroad bridge. From this point on up to Prado Dam, both trails will be located on an existing dirt farm road adjacent to the Chino Hills State Park currently being developed by the State of California Department of Parks and Recreation. This stretch of trail is on open ranch land in a natural grassland environment. It has been requested by the State and the local counties that we do not disturb or change the nature or environmental characteristics within the Santa Ana Canyon. The canyon contains several distinct and diverse biological communities ranging from the ephemerally inundated community along the river through the riparian, grassland, upland chaparral, to the oak woodland at higher elevations. The ecological value is not only in the communities themselves but in the diverse and varied ecotones created petween these communities. In view of the above considerations no additional landscaping along the recreation trails is proposed throughout this reacn. No landscaping costs are presented in table D-4, on page D-IX-2. A discussion of the recommended landscape and erosion control plan is included in the General Design Memorandum, Volume 3, on page D-XII-1.

IX. COSTS

General

9-01 All separable costs attributed to recreation will be cost shared on a 50/50 basis with local interests. The bike and equestrian trails will be constructed concurrent to the flood control project.

Cost Summary and Estimate

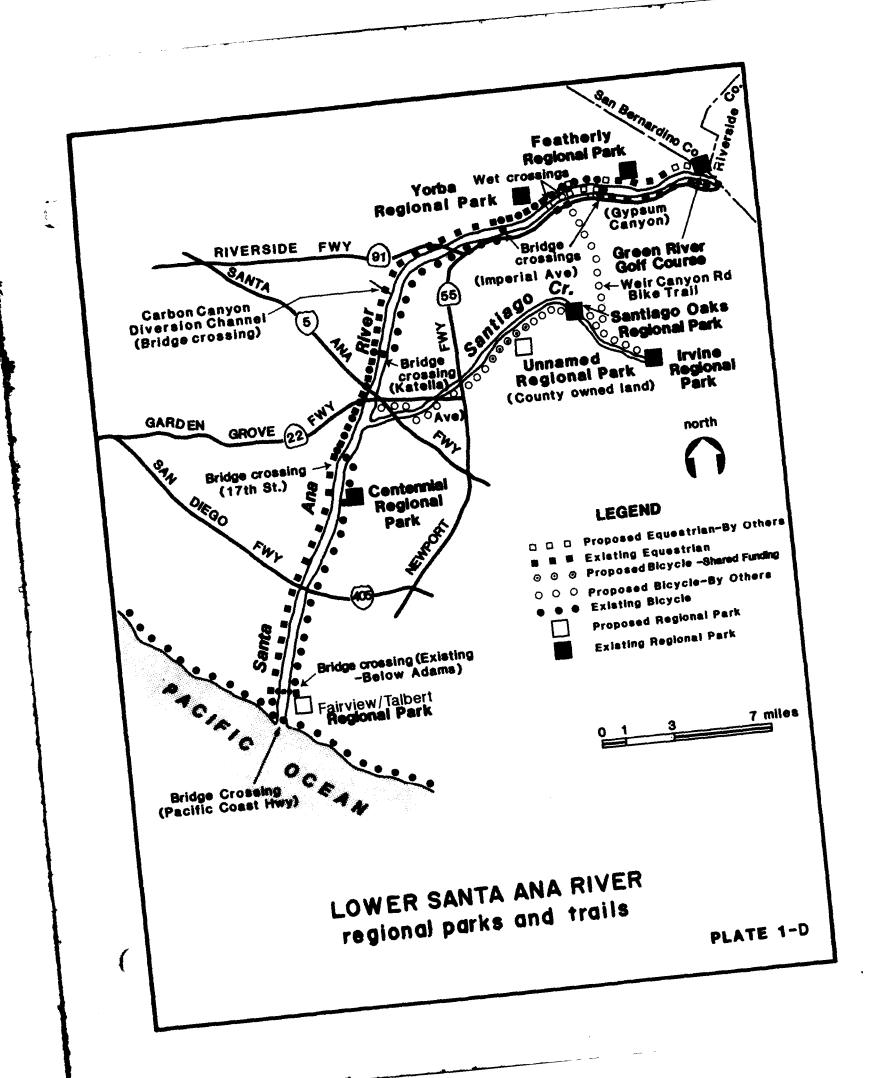
9-02 A detailed cost estimate for the proposed bicycle and equestrian trails is presented in table D-4.

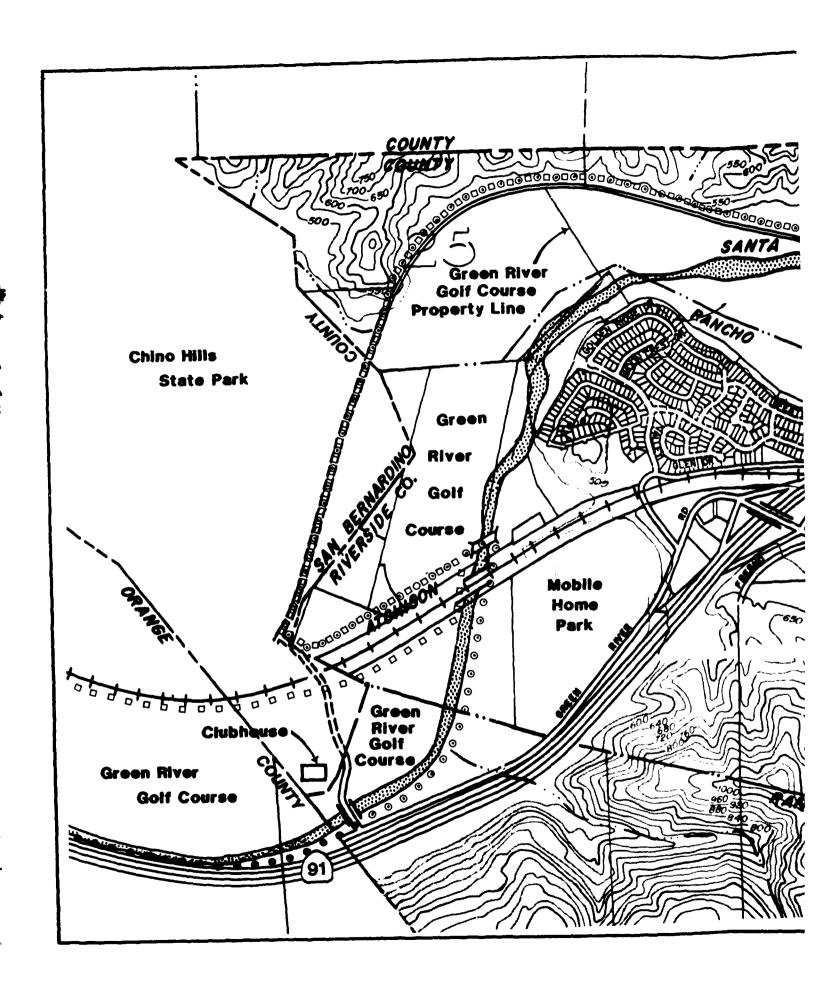
Table D-4. Recreational Development Cost Estimate.
Santa Ana River Canyon

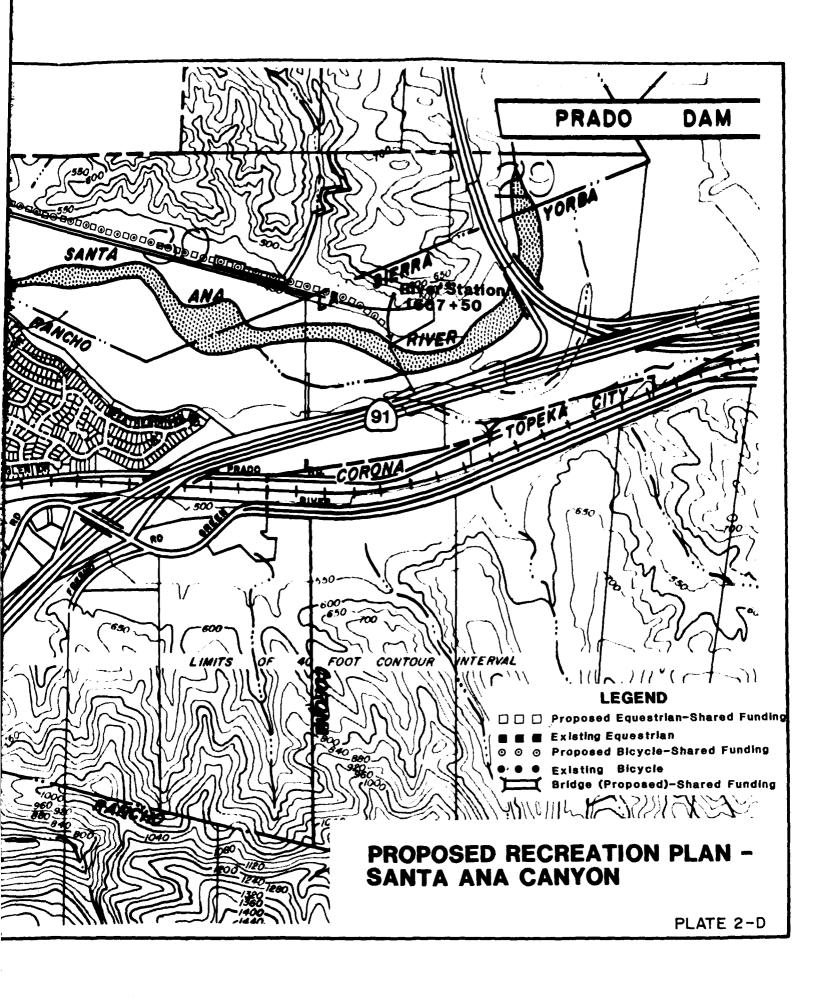
Description	Quantity	Unit	Unit Cost	Totals
Bike Trail	18,100	LF	17.50	316,750.00
Equestrian/Hiking Trail	21,375	LF	4.50	66,200.00
Bridge (10' x 90')	1	EA	65,000	65,000.00
Signs (Marker)	18,100	LF	•25	4,525.00
Signs (Entrance-Directional)	10	EA	600	6,000.00
Signs (Traffic)	6	EA	600	3,600.00
Gate	1	EA	1,000	1,000.00
Subtotal				463,074.00
Contingencies Suptotal				67,926.00 531,000.00
Engineering and Design				37,000.00
Supervision & Administration TOTAL RECREATION				32,000.00 600,000.00

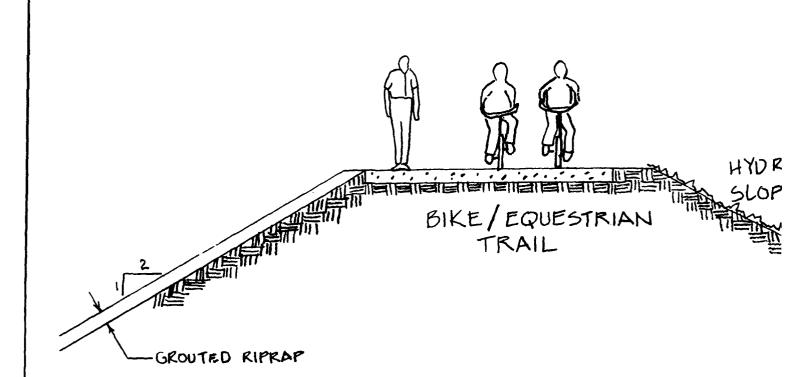
D RECREATION

PLATES AND ATTACHMENT

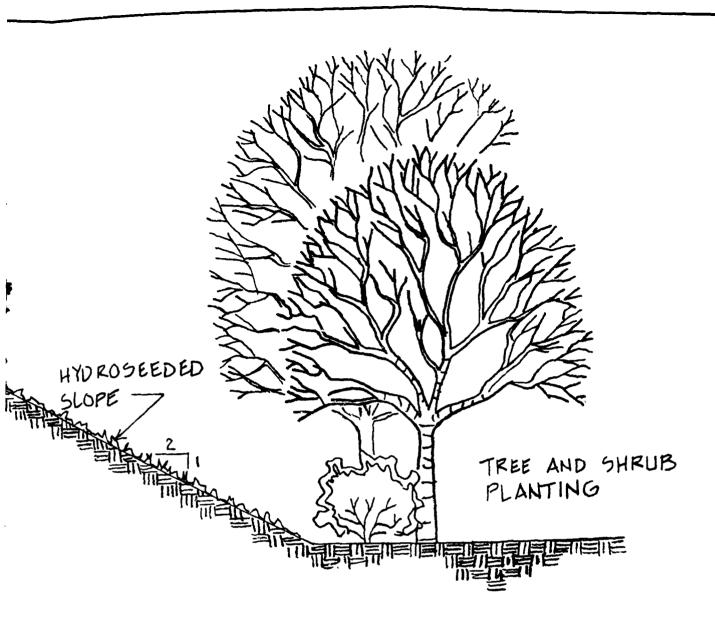






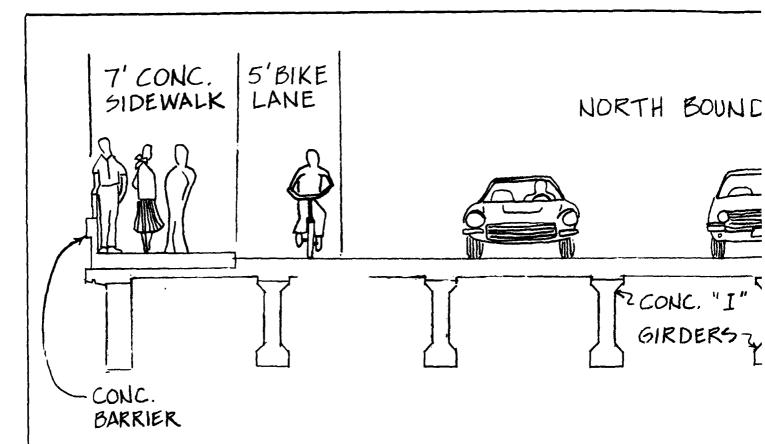


TYPICAL TRAIL SECTION ON TO

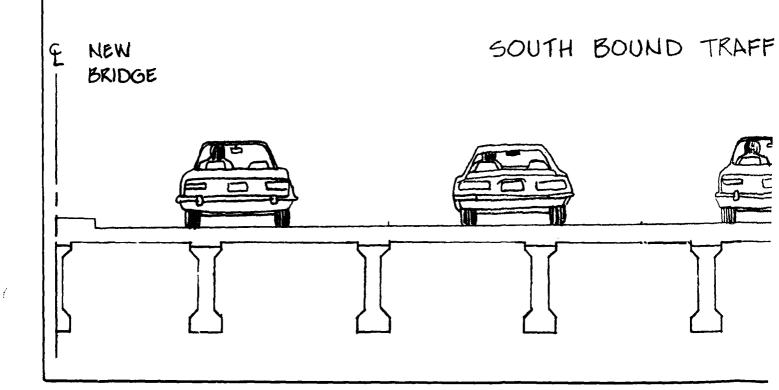


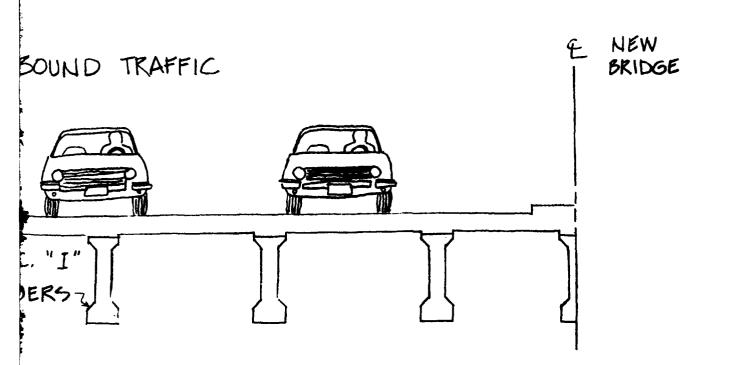
ON TOP OF LEVEE

SCALE : |" = 4'



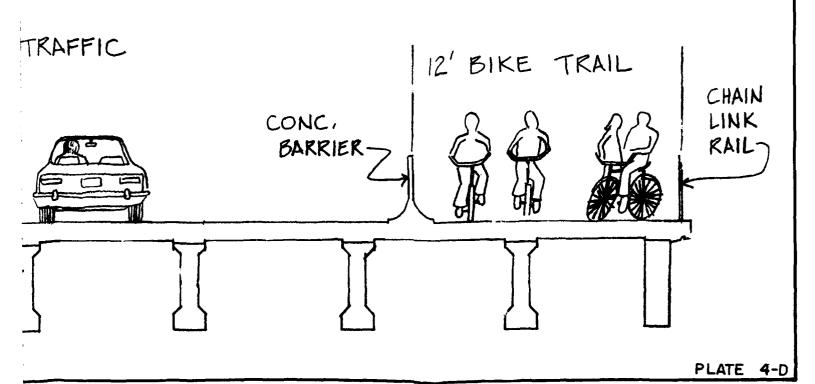
BIKE TRAIL ON TOP OF BRIDGE

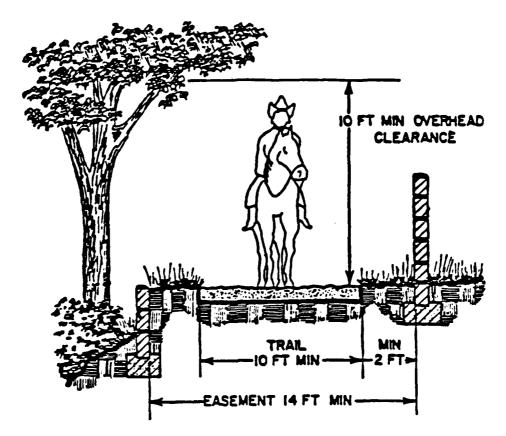




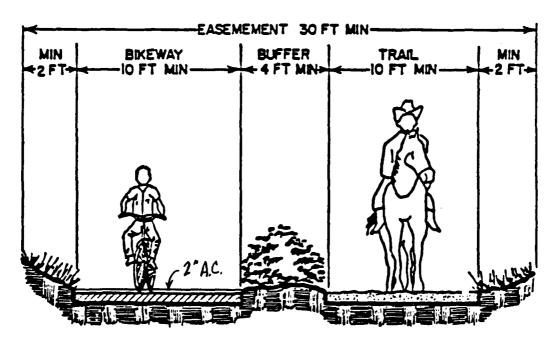
IDGE AT PACIFIC COAST HWY

SCALE: 1"=4'





EQUESTRIAN TRAIL



TRAIL AND BIKEWAY COMBINATION

TRAIL DETAILS

COUNTRACT BETWEEN THE UNITED STATES OF AMERICA AND COUNTRY OF ORANGE

COUNTY OF ORANGE FOR

RECREATION DEVELOPMENT
MAINSTEM FEATURE
OF THE

SANTA ANA RIVER FLOOD CONTROL PROJECT SANTA ANA RIVER BASIN, CALIFORNIA

THIS CONTRACT entered into this day of , 19 by and between the UNITED STATES OF AMERICA (hereinafter called the "Government"), represented by the Contracting Officer executing this contract and the County of Orange (hereinafter called "County"),

WITNESSETH THAT:

WHEREAS, construction of the lower reach of the Santa Ana River Flood Control Project, Santa Ana River Basin, Orange County, California (hereinafter called the "Project") was authorized by the Flood Control Act of 1944 (Public Law 534, 78th Congress); and

WHEREAS, pursuant to Section 4 of the 1944 Flood Control Act, as amended by Section 207 of the 1962 Flood Control Act, as amended (16 U.S.C. 460d), the Government is authorized to make contracts with non-Federal public bodies for development, management, and administration of the recreation resources of Federal water resources projects; and

WHEREAS, the office of Chief of Engineers has established certain policy for recreation development at Federal non-reservoir water resources projects consistent with Congressional intent as expressed in the Federal Water Resource Project Recreation Act of 1965 (Public Law 89-72).

NOW, THEREFORE, the parties agree as follows:

ARTICLE 1 - DEFINITION OF TERMS. For the purpose of this contract certain terms are defined as follows:

- (a) First Costs: Used interchangeably with the terms "capital costs" and "project costs," are the initial capital costs of the recreation features of the project, including: engineering, design, supervision, and administration; land acquisition and construction.
- (b) Recreation lands: Project lands acquired for flood control or other project purposes as described in a joint use agreement with the Flood Control District of Orange County.
- (c) Recreation facilities: Those facilities for recreation which may be installed pursuant to this agreement.

ARTICLE 2 - LANDS AND FACILITIES.

- (a) The County is required to provide all recreation lands through a joint use agreeement with the Flood Control District of Orange County (hereinafter called the "District"). Lands not required for the construction and operation of the flood control project are not subject to the provisions of this contract.
- (b) The Government, in cooperation with the County, will prepare a mutually acceptable General Design Memorandum-Phase II which will depict and identify the types and quantities of recreation facilities which the Government and the County of Orange will construct in accordance with this contract. The presently estimated cost of facilities to be provided is contained in Exhibit A, entitled "Estimated Recreation First Cost", attached hereto and made a part hereof. Such estimate of facility cost is subject to reasonable adjustment as appropriate upon approval of the above mentioned Phase II General Design Memorandum.
- (c) The facilities as shown in Exhibit A, as it may be adjusted in accordance with paragraph (b) above, shall be constructed jointly by the parties through mutually satisfactory division of responsibility for construction that takes into account direct and indirect cost savings which may be gained by the parties in the public interest for certain specific facilities, provided, that the facilities to be constructed by each party shall be formally agreed upon by the two parties prior to construction, consistent with the provisions of Article 3.
- (d) Title to all lands and recreation facilities constructed on flood control project lands, shall at all times be in the County and the County shall not transfer title to any non-public entity. The County shall, under this agreement, dedicate the land for recreation use.
- (e) The performance of any obligation or the expenditure of any funds by the Government under this contract is contingent upon Congress making the necessary appropriations and funds being allocated and made available for the work required hereunder.
- ARTICLE 3 CONSIDERATION AND PAYMENT. Each party hereto will pay or contribute in kind fifty percent (50%) of the first costs of recreation development.
- (a) Development. Fifty percent (50%) of the estimated first costs of recreation development is estimated to be \$300,000. Prior to the advertisement of the first construction contract hereunder and again prior to the advertisement of each subsequent construction contract thereafter, the Government Contracting Officer shall calculate the estimated expenditures which each party shall have made up to the time of advertising of the applicable contract. If the total estimated expenditures by the Government shall exceed those of the County, the County shall pay to the Government such sum as will equalize the expenditures of both parties, prior to award of such contract. In computing expenditures, there shall be considered, in addition to cash expenditures, contributions in kind such as facilities, at the fair market value thereof at the time such land and facilities are provided,

which value shall not include enhancement due to the project. Upon completion of recreation development, an adjustment will be made on the basis of actual costs incurred. It is understood and agreed that the County's share of the cost of the construction shall be computed on the basis of actual costs to the Government of the work included in the Government construction contract above and on the basis of unit prices in the Government contract and final quantities covering labor, materials, and equipment required for the work under the Government construction contract plus the actual amount, estimated at thirty-one percent (31), of the Government's costs for engineering, design, supervision and administration and not on the basis of prior estimates.

- (b) Other Federal Funds. No payment credit of any kind whatsoever will be allowed the County for expenditures financed by, involving, or consisting of, either in whole or in part, contributions or grants of assistance received from any Federal agency in providing any lands or facilities for recreation enhancement hereunder.
- (c) Adjustments to Reflect Costs. The dollar amounts set forth in this Article are based upon the Government's best estimates, and are subject to adjustments based on the costs actually incurred. Such estimates are not to be construed as representations of the total financial responsibilities of each of the parties.
- ARTICLE 4 CONSTRUCTION AND OPERATION OF ADDITIONAL FACILITIES.
 Certain types of facilities including but not necessarily limited to restaurants, lodges, golf courses, cabins, clubhouses, overnight or vacation-type structures, stables, marinas, swimming pools, commissaries, chairlifts, and such similar revenue-producing facilities may be constructed by the City or third parties and may be operated by the City or by third parties on a concession basis. Any such construction and operation of these types of facilities shall be compatible with all project purposes and shall be subject to the prior approval of the Contracting Officer. However, the County shall not receive credit for costs of such facilities against amounts due and payable under Article 3.
- ARTICLE 5 FEE AND CHARGES. The County may assess and collect fees for entrance to developed recreation areas and for use of the project facilities and areas, in accordance with a fee schedule mutually agreed to by the parties. Not less often than every five (5) years, the parties will review such schedule and upon the request of either, renegotiate the schedule. The renegotiated fee schedule shall, upon written agreement thereto by the parties, supersede prior schedules without the necessity of modifying this contractual document.

ARTICLE 6 - FEDERAL AND STATE LAWS.

(a) In acting under its rights and obligations hereunder, the County agrees to comply with all applicable Federal and State laws and regulations, including but not limited to the provisions of the Davis-Bacon Act (40 U.S.C. 276 a-a (7); the Contract Work Hours and Safety Standards Act (40 U.S.C. 327-333); and part 3 of Title 29, Code of Federal Regulations.

- (b) The County furnishes its assurances that it will comply with Title VI of the Civil Rights Act of 1964 (78 Stat. 42 U.S.C. 2000d, et seq) and Department of Defense Directive 5500.11 issues pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations. The County agrees also that it will obtain such assurances from all its concessionaires.
- (c) The County furnishes its assurances that it will comply with Sections 210 and 305 of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646).

ARTICLE 7 - OPERATION AND MAINTENANCE. The County shall be responsible for operation, maintenance, and replacement without cost to the Government, of all facilities developed to support Project recreation opportunities. The City shall maintain all recreation project lands, waters and facilities in a manner satisfactory to the Contracting Officer.

ARTICLE 8 - RELEASE OF CLAIMS. The Government and its officers and employees shall not be liable in any manner to the County for or on account of damage caused by the development, operation, and maintenance of the recreation facilities of the Project. The County hereby releases the Government and agrees to hold it free and harmless and to indemnify it from all damages, claims, or demands that may result from development, operation, and maintenance of the recreation areas and facilities. The County will not be responsible for Corps negligence or that of the construction contractor during the time the Corps is supervising such construction.

ARTICLE 9 - TRANSFER OR ASSIGNMENT. The County shall not transfer or assign this contract nor any rights acquired thereunder, nor grant any interest, privilege or license whatsoever in connection with this contract without prior approval of the Secretary of the Army or his authorized representative except as provided in Article 4 of this contract.

ARTICLE 10 - DEFAULT. In the event the County fails to meet any of its obligations under this agreement, the Government may terminate the whole or any part of this contract. The rights and remedies of the Government provided in this Article shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

ARTICLE 11 - EXAMINATION OF RECORDS. The Government and the County shall maintain books, records, documents, and other evidence pertaining to costs and expenses incurred under this contract, to the extent and in such detail as will properly reflect all net costs, direct and indirect, of labor, materials, equipment, supplies, and services, and other costs and expenses of whatever nature involved therein. The Government and the County shall make available at their offices at reasonable times, the accounting records for inspection and audit by an authorized representative of the parties to this contract during the period this contract is in effect.

ARTICLE 12 - RELATIONSHIP OF PARTIES. The parties to this contract act in an independent capacity in the performance of their respective functions under this contract and neither party is to be considered the officer, agent, or employee of the other.

ARTICLE 13 - INSPECTION. The Government shall at all times have the right to make inspections concerning the operation and maintenance of the lands and facilities to be provided hereunder.

ARTICLE 14 - OFFICIALS NOT TO BENEFIT. No member or delegate to the Congress, or Resident Commissioner, shall be admitted to any share or part of this contract, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this contract if made with a corporation for its general benefits.

ARTICLE 15 - COVENANT AGAINST CONTINGENT FEES. The County warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon agreement or understanding for a commission, percentage, proker-age, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the County for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or in its discretion to add to the contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE 16 - ENVIRONMENTAL QUALITY.

- (a) In furtherance of the purpose and policy of the National Environmental Policy Act of 1969 (Public Law 91-190, 42 U.S.C. 4321, 4331-4335) and Executive Order 11514, entitled "Protection and Enhancement of Environmental Quality," March 5, 1970 (35 Federal Register 4247, Mar 7, 1970) the Government and the County recognize the importance of preservation and enhancement of the quality of the environment and the elimination of environmental pollution. Actions by either party will occur after considerations of all possible effects upon the Project Environmental Resources and will incorporate adequate and appropriate measures to insure that the quality of the environment will not be degraded or unfavorably altered.
- (b) During construction and operation undertaken by either party, specific actions will be taken to control environmental pollution that could result from their activities and to comply with applicable Federal, State and local regulations concerning environmental pollution. Particular attention should be given to (1) reduction of air pollution by control of burning, minimization of dust, containment of chemical vapors, and control of engine exhaust gases and smoke from temporary heaters; (2) reduction of water pollution by control of sanitary facilities, storage of fuels and other contaminants, and control of turbidity and siltation from erosion; (3) minimization of noise levels; (4) on and off site disposal of waste and spoil activities; and (5) prevention of landscape defacement and damage; and (6) reduction of groundwater mining through safe-yield pumping of wells.

ARTICLE 17 - EFFECTIVE DATE. This contract shall take effect upon approval by the Secretary of the Army or his authorized representative.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA	THE COUNTY OF ORANGE
By Colonel, Corps of Engineers District Engineer Contracting Officer	By Chairman, Board of Supervisors
DATE	ATTEST:
APPROVED:	(Title)

DATE

Exhibit A

Estimated Recreation First Cost Santa Ana River Mainstem, including Santiago Creek - County of Orange Mainstem Feature

Item No.	Description	Local Cost	Federal Cost
1.	Bike Trail	\$158,375	\$158,375
2.	Equestrian/Hiking Trail	33,100	33,100
3.	Bridge (10' x 90')	32,500	32,500
4.	Signs (Marker)	2,262	2,262
5.	Signs (Entrance/Directional)	3,000	3,000
6.	Signs (Traffic Control)	1,800	1,800
7.	Gate	500	500
	Subtotal	\$231,537	\$231,537
	Contingencies	33,963	33,963
	Subtotal	265,500	265,500
	Engineering and Design	18,500	18,500
	Supervision and Administration	16,000	16,000
	TOTAL RECREATION	\$300,000	\$300,000

Exhibit B

Title

E SIDE DRAIN TABULATION

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100-YEAR LOCAL STORM PEAK DISCHARGE

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

<u> </u>	2	2	PERTINENT INFORMATION	5	SIDE - DKAINA	AINAGE INVESTIGATION	X 2 C C C X	SANIA ANA KIVER	14 A
		SUBAREA	REA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
DRAIN	NAME	AE SIZE SQ. HZ.	DISCHARGE PEAK C.F.S.		DRAIN CAPACITY CF8	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
				680	1800	RECT CHANNEL	1206+96	JOIN EXIST BOX	NO EXCESS FLOW
vi				360	360	1 1 1 1 1 1	1202104	JOIN EXIST PIPE	NO EXCESS FLOW
	<i>p</i> ,	28.0	1100						
W				80	140	* 72" RCP	1189.90	LOIN EXIST PIPE	NO EXCESS FLOW
4				80	240	* 72" RCP	08+68//	JOIN EXIST PIPE	NO EXLESS FLOW
									
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TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

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TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

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TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

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100 12 - 8'x 6' 12.00 1163400 1010 EXIST BOX 100 EXCESS 800 800 12 - 6'x 5' R.C.				,					
800 12 - 6' x 5' RCR 157490 JOIN EXIST FOOK NO EXCESS 15 42 24" RCP 159440 JOIN EXIST PIPE NO EXCESS 16 45 24" RCP 14570 JOIN EXIST PIPE NO EXCESS 18 670 3' x 6' RCR Existing 13470 JOIN EXIST ROX NO EXCESS NO EXCESS NO EXCESS NO EXCESS NO EXCESS NO EXCESS NO EXCESS NO EXCESS NO EXCESS NO EXCESS NO EXCESS PROVIDE OPN'G FOR 15 32 24" RCP 124440 JOIN EXIST PIPE NO EXCESS PROVIDE NO EXCESS				28	000/	, w	1163100	EX157	EXCESS
Soo Soo 12 - G'x 5' RC 16 57490 John Exist 130x No excess Soc 24" Rc 10 5440 John Exist 1919E No excess Soc 24" Rc 10 5440 John Exist 1919E No excess Soc 24" Rc 10 4540 John Exist 1919E No excess Soc 24" Rc 10 4540 John Exist 1919E No excess Soc 24" Rc 10 12440 124	22.1 "0"		1500			l			
FREEWAY BOXES 15446 JOIN EXIST PIPE NO EXCESS F 5 42 24" RCP 150190 JOIN EXIST PIPE NO EXCESS F 6 45 24" RCP 145190 JOIN EXIST PIPE NO EXCESS F 180 670 3'x6" RCP (PROPOSE) PROVIDE OPN'G FOR 1241 RCP 124				800	800		1157+90	EXIST	EXCESS
15 42 24" RCP 154+46 Join Exist PIPE NO Excess 154+46 Join Exist PIPE NO Excess 150+76 Join Exist PIPE NO Excess 176									
15 42 24" RCP 154.46 Join Exist PIPE NO Excess 154.46 Join Exist PIPE NO Excess 154.76 Join Exist PIPE NO Excess 145.40 Join Exist PIPE NO Excess 145.40 Join Exist Box NO Excess 148" RCP (PROPOSE) 124,40 Join Exist PIPE NO Excess 124,40 Join Exist PIPE NO Excess 124,40 Join Exist PIPE NO Excess 15 32 24,80P	1			1					
15 45 24" RCP		_		3	42	>	1154+40	EXIST	EXCESS
15 45 24" RCP 150190 101N EXIST PIPE NO EXCESS 16 37 24" RCP 1145190 101N EXIST PIPE NO EXCESS 180 670 3'x6' RCB (EXISTING) 134170 101N EXIST BOX NO EXCESS 15 32 24" RCP 1124140 101N EXIST PIPE NO EXCESS F									
16 37 24" RCP		_		'n	45	RCP	1150+90	Ex15T	ExCESS
16 37 24" RCP									1 1
180 610 3'x 6' RCB (EXISTING) 13470 JOIN EXIST BOX NO EXCESS 1 48" RCP (PROPOSED) PROVIDE OPN'G FOR 100 EXCESS 1 49" RCP (PROPOSED) 49" RCP 124140 JOIN EXIST PIPE NO EXCESS 7	0.69	_	640	3/	87	" 0.0	1115.49	2000	77.6
670 3'x 6' RCB (EXISTING) 134+70 JOIN EXIST BOX NO EXCESS 48" RCP (PROPOSE) PROVIDE OPN'G FOR 40" RCP 32 24* RCP 24+40 JOIN EXIST PIPE NO EXCESS P							2/	27131	CACCOS
### ### ### ### ### ### ### ### ### ##				700	(1)	-///			
48" RCP (PROPOSED) PROVIDE OPN'G FOR 48" RCP 32 24" RCP (124,40 JOIN EXIST PIPE NO EXCESS	•	_		90	0/0	XG KCB (EXISTING)	1134+70	Ex/57	EXCESS
32 24" RCP 1124,40 JOIN EXIST PIPE NO EXCESS						RCP			
32 24" RCP 1124,40 JOIN EXIST PIPE NO EXCESS								1 1	
32 L4T KCP 1124,40 JOIN EXIST PIPE NO EXCESS				7/	,	,			
		⅃	1	(2)	32	RCP	1124140	Ex157	EXCESS
		J							

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

TOTAL	TOTAL SIDE-DRAMAGE REQUIREMENTS STATION	1074 SIDE-DRAMAGE REQUIREMENTS STATION REMARKS DISPOSITION OF DICESS 1000 100	핗	늘	NTO NTO	RMATIO	8	PERTINENT INFORMATION ON SIDE-DRAINA	GE INVESTIGATION -	Lower	SANTA ANA RIVER	, K
1070 1000	TOTAL SIDE-DAMMGE REQUIREMENTS STATION	1/2 1014 SIDE-DRAMME REQUIREMENTS STATION STATION STATION STATION STATION STATION C.S. 2.1. C.S. 2.4. C.C. 2.1.							LEFT BANK			
DISCHARGE 0 105			ns		ARE/		TOTAL	5,	IDE-DRAMAGE REQUIREMENTS			
	120 100 2)- 6'x8' RCR 1449 1010 Exist Pipe 100 Excess 20 45 24" RCP 10519 000 Exist Pipe NO Excess F		NAME SI				O CFS		DESCRIPTION	STATION	FEMARKS	DISPOSITION OF EXCESS FLOW
1/20 1/20	1/20 20 46 24" RCP 116549 JOIN EXIST PIPE NO ÉXCESS A	1/20 20 46 24" RCP 110519 JOIN EXIST PIPE NO EXCESS R			_	J	00//			7	1	
1120 20 45 24" RCP 110540 JOIN EXIST PIPE NO EXCESS	1120 20 45 24" RCP 115590 1010 EX 157 1910E 100 EX 10555	1/20 20 45 24" RCP 1105190 JOIN EXIST RIPE NO ÉXCESS						00//		0/14/	CX (2)	CXCESS
1120 20 46 24" RCP 1105190 JOIN EXIST PIPE NO ÉXCESS.	1120 26 24" RCP 105190 JOW EXIST PIPE NO EXCESS	1120 46 24" RCP 1105790 JOIN EXIST PIPE NO EXCESS	_			<u></u>						
20 46 24" RCP WESTA JOW EXIST PIPE NO ÉXCESS.	20 45 24" RCP 10540 JOIN EXIST PIPE NO EXCESS	10 45 24" RCP 105190 JOIN EXIST PIPE NO EXCESS	200	•		- 01/						
46 24" RCP 105190 JOIN EX 151 PIPE NO ÉXCESS	46 ld" RCP W6:190 Join Exist PIPE NO Excess	45 24" RCP 1105190 JOIN EXIST PIPE NO ÉXCESS		_		02//						
46 24" RCP 110519 JOIN EXIST PIPE NO EXCESS	46 24" RCP 110540 JOW EXIST PIPE NO EXCESS	46 24" RCP 110540 JOIN EXIST PIPE NO ÉXCESS										
					_		20	30	24" RCP	1105+90	Ex 15T	EXCESS
					_	7						
			_									
			_									
					 ,							
			\dashv	- 1								

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

			-				R.SAT BANK	N		
700		SUBAREA	EA	TOTAL		SDE-D	SIDE-DRAINAGE REQUIREMENTS			
4	NAME	SIZE Siq. ML	DISCHARGE PEAK C.F. S.	0 CFS	INDIVIDUAL 9 CF.S.		DESCRIPTION	STATION	PEMAPKS	DISPOSITION OF EXCESS FLOW
97				40	70	*	48" CMP	174+95	JOIN EXIST PIPE	NO EXCESS From
67	ED	0.	120	40	//0	*	72" CNP	00+69//	JOIN EXIST PIPE	NO EXCESS FLOW
30				45	0//	Ng.	72" CMP	06+89//	JOIN EXIST PIPE	NO EKCESS FLOW
# 22 M	OVER AT ,	OVERLAND 47 REGIL	Land Flow	2 0	DRAINS	ļ	1NTO DROP ST.	STRUCTURES	:65	

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

TOST AND 22 "CTT 1/1

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

No. No.							RIGHT BANK	2020	SENIE UNB	KIVEK
35 12 DESCRIPTION STATION REMANNS DESCRIPTION STATION REMANNS DESCRIPTION OF EXCESS 36 12 0.55 0.60 0.77 1184-15 10.10 0.75 717 717 717 717 718			SUBAR	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
10 500 72" CMP 146+16 101N EXIST PIPE NO EXCESS 10 500 72" CMP 118+90 101N EXIST PIPE NO EXCESS 10 600 CO" CMP 118+90 101N EXIST PIPE NO EXCESS 10 600 CO" CMP 118+90 101N EXIST PIPE NO EXCESS 100 240 54" RCP 118+10 101N EXIST PIPE NO EXCESS 140 1600 (3)-72" CMP 1099+20 101N EXIST PIPE NO EXCESS 140 1600 (3)-72" CMP 1095+20 101N EXIST PIPE NO EXCESS	2 2				O. C.F.S.	INDIVIDUAL 9 CF.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
34 FG 0.35 650 60 72" CMP 114100 101N EXIST PIPE NO EXCESS 36 10 100 100 000 000 000 000 000 000 000	3				90	230	66" CMP	1/46+50	EXIST	EYCESS
34 To Sove 72" CMP 118-40 JOIN EXIST PIPE NO EXCESS 36 60 120 39" RCP 118-40 JOIN EXIST PIPE NO EXCESS 36 60 120 60" CMP 114-10 JOIN EXIST PIPE NO EXCESS 37 80 100 60" CMP 114-10 JOIN EXIST PIPE NO EXCESS 39 100 240 54" RCP 1099-12 JOIN EXIST PIPE NO EXCESS 39 100 240 54" RCP 1099-12 JOIN EXIST PIPE NO EXCESS										
35	200				,	000	000 1101	77.		
36 FG 0.35 650 60 40 60° CMP 111349 101N EXIST PIPE NO EXCESS 1 30 100 140 54" RCP 111447 101N EXIST PIPE NO EXCESS 1 30 140 54" RCP 1094:8 101N EXIST PIPE NO EXCESS 1 39 140 54" RCP 1094:8 101N EXIST PIPE NO EXCESS 1					ś		12 2711	114/400	1	EXCESS
36 FG 0.35 650 60 120 39 RCF 11349 JOIN EXIST PIPE NO EXCESS 1 36 100 60 CM CMP 112447 JOIN EXIST PIPE NO EXCESS 1 36 100 340 54" RCP 109942 JOIN EXIST PIPE NO EXCESS 1 39 240 54" RCP 109942 JOIN EXIST PIPE NO EXCESS 1 39 240 54" RCP 109942 JOIN EXIST PIPE NO EXCESS 1	35	1-			`	,	0 0 000			1 1
36 FG 0.35 GEO 60 CMP 1124-91 JOIN EXIST PIPE NO EXCESS 1 37		2			eo	3	SA" KCF	11/3+90	EX16T	Excess
37 (50 100 CMF 1124+9) JOIN EXIST PIPE NO EXCESS 38 100 140 54" RCP 1099+28 JOIN EXIST PIPE NO EXCESS 39 (140 54" RCP 1099+28 JOIN EXIST PIPE NO EXCESS 39 (140 54" RCP 1095+38 JOIN EXIST PIPE NO EXCESS 39 (140 600 (3)-72" CMP 1095+38 JOIN EXIST PIPE NO EXCESS	7	122		_	,	Ş				
31 (50 200 CG" CMP 11/4-20 JOIN EXIST PIPE NO EXCESS 39 (100 140 54" RCP 1099+20 JOIN EXIST PIPE NO EXCESS 39 (140 1000 (3)-72" CMP 1095+30 JOIN EXIST PIPE NO EXCESS	à				e	20		1124+97	Ex157	
30 (200 (36" CMP III/4-20 JOIN EXIST PIPE NO EXCESS 1 30 (40 54" RCP 1099+20 JOIN EXIST PIPE NO EXCESS 1 39 (40 54" RCP 1099+20 JOIN EXIST PIPE NO EXCESS 1	-									
39 (100 (3)-12" CMP (1095-56 10)N EXIST PIPE NO EXCESS 1	37				0,	200	66" CMP	11/4+20	EXIST	EXCESS
39 100 140 54" RCP 1099+20 JOIN EXIST PIPE NO EXCESS. 1		·			.					
39 100 140 54" RCP 1099+26 JOIN EXIST PIPE NO EXCESS. 39 140 1000 (3)-72" CMP 1095+36 JOIN EXIST PIPE NO EXCESS.	-				1!					
39 (40 1000 (3)-72" CMP 1095+30 101N EXIST PIPE NO EXCESS	20				8	240	54" RCP	02+6601	EX15T	1 1
39 140 1000 (3)-72" CMP 1095+36 JOIN EXIST PIPE NO EXCESS		_								
					140	000/	1 I	1095+30	EXIST	EXCESS
								-		
							·			

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

			SS FLOW	FLOW			Frow		From							
ER			DISPOSITION OF EXCESS FLOW	NO EXCESS F			NO EXCESS		NO EXCESS !							·
SANTA ANA RIVER			REMARKS	JOIN EXIST, PIPE			JOIN EXIST PIPE		JOIN EXIST PIPES							
OWER			STATION	1130+50			1130+50		1116+70				-			
GE INVESTI	RIGHT BANK	SIDE-DRAINAGE REQUIREMENTS	DESCRIPTION	72" RCP			42ºRCP		60 & 84" RCP		-			:		
ON SIDE-DRAINA		S	INDIVIDUAL Q CFS.	oap			08/		002/							
		TOTAL	C.F.S.	400			90	0	200							
PERTINENT INFORMATION		EA	DISCHARGE PEAK C.F.S.				1040									
N IN		SUBAREA	\$1.2E 54. ML				0.87									
RTEN			MARE			" "	u								 	
8			ğ	40			4	,	7							

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

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ORAIN SUBAREA DE DE MANE SI ZE MANE SI ZE MANE SI ZE MANE SI ZE MANE MANE SI ZE MANE MANE MANE MANE MANE MANE MANE MAN	EA			RIGHTBANK				
NAME		TOTAL	<i>y</i> ,	SIDE-DRAINAGE REQUIREMENTS				
	DISCHARGE PEAK C.F.S.	C.F.S.	INDIVIDUAL Q CF.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW	EXCESS FLOW
		7						1
43		\$	80	36" RCP	1076+40	JOIN EXIST PIPE	E NO EXCESS	SS FLOW
				W/ FLOP GOTS				
17 0.10	/30			,				
-					1			
44		90	180	54" RCP	075470	JOIN EXIST PIPE	DE NO EXCESS	15. FLOW
	<u> </u>							J
_	-							

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

101AL SUBMERA 101AL SUB-DIAMAGE REQUIREMENTS NEMARS DOSCUMBRENTS STATION NEMARS DOSCUMBRENTS STATION NEMARS DOSCUMBRENTS STATION NEMARS DOSCUMBRENTS STATION STATION NEMARS DOSCUMBRENTS STATION NEWARS STATION STATION NEWARS STATION NEWARS STATION NEWARS STATION NEW PEER STATIO	**************************************	2	RTINE	N IN	PERTINENT INFORMATION ON SIDE-DRAINA	NO N	NDE-DRA	GE INVESTIGATION -	70mer	SANTA ANA	RIVER
MAME 312 DECLARAGE REQUIREMENTS NOTAL STATION NEW STATION STATIAN STATION STATION STATION STATION STATION STATIO	1.54 1250 1250 4600 (3) - 12'X7' RC'S 1075'10 1010 54.05'S 1010 10							LEFT BANK			
**************************************	**************************************			SUBAR	EA	TOTAL	-	SIDE-DRAMAGE REQUIREMENTS			
"," "," "," "," "," "," "," "," "," ","	7. "4" 2:54 2:50 2:50 4:50 (3) - 12/X7' R.C.B 1076:40 JOIN EXIST BOK NO EXCESS 7. "5" 0:51 7720 (3) - 8/X7' R.C.B 1075:00 folio Exist Box Rowing RESS. 24 30 24" R.L.P 1060 1000 Exist Pipe NO Excess 25 30 24" R.L.P 1060 1000 Exist Pipe NO Excess 26 40 60 48" R.C.P 1060 106 Filth GATE NO Excess	3 4	HAME	S1 2E 54.M.		O CFS		DESCRIPTION	STATION	PEMARKS	DISPOSITION OF EXCESS FLOW
"3. 0.57 1720 (188 1440 (3) -8'x7' R.C. 1055100 101N EXIST. BOX ROADING AREA OF SHEES 10E 10E 1720 1720 1720 1720 1720 1720 1720 1720	36 30 37 1720 (1335 1440 (3) - 8'x7' R.C.P. 1075100 1010 EXIST. POX PONOMO REEA. 1.4 (Existing) 24 (Existing) 25 30 24 R.C.P. (06118) 1010 Exist PIPE NO EXESS. 10 100 49" R.C.P. (106115) 1010 Exist PIPE NO EXESS.	15	" "	2.54		2250	4500	-12'X7'	1096140	Ex157	111
17. 4. 0.57 1720 1735 1440 (3) - 8×7' R.C.P. 1075100 401N EXIST. BOX PONDING PREAD 1. N.C.M. 15 OUTS.) 20	"," "," "," "," "," "," "," ","										
"," 1.55 1720 1855 1440 (3) - 8'x7' R.C.B. 1075100 401N EXIST. BOX 70NDING AREA (Existing) 1005 1000 Exist Box 70NDING AREA (Existing) 1000 1000 Exist Box 70NDING AREA 20 24" R.C.P. 1065180 101N Exist Pipe 100 Exists 100 Exis	"," 4" 0.57 1720 (185 440 (3) - 8'x7' R.C.B. 1075100 JOIN EXIST. BOX ROUNG BREAD LAWCH IS OUTS. 20 24" R.C.P. 1065180 JOIN EXIST PIPE NO EXCESS 10 100 48" R.C.P. 1065180 JOIN EXIST PIPE NO EXCESS	l									
20 57 1720 1733 1440 (3) - 8'x7' RCB 1075100 1010 EX157, BOX PONDING REEA 1.2.	26 1720 188 1440 33 - 8'x7' R.C.P. 1075120 4010 EXIST. BOX POLICING AREA 26 24" R.C.P. 1065120 4010 EXIST. BOX POLICING AREA 26 24" R.C.P. 1065120 1010 EXIST. PIPE NO EXCESS 27 100 48" R.C.P. 1061150 1010 EXIST. PIPE NO EXCESS 29 100 48" R.C.P. 1061150 1010 EXIST. PIPE NO EXCESS 20 100 48" R.C.P. 1061150 1010 EXIST. PIPE NO EXCESS		,								
20 24" RLP 1000 Exist box 1000 Exists box 1000 grees because where a sign box 1000 grees because where a sign box 1000 gries because of the content of the c	20 24 RLP 1010 Exist box 10001118 AREA 20 24 RLP 10658 1010 Exist pipe NO Excess 10 100 48" RCF 10615 PROUDE FLAP GATE	2	- w			1024		12-10-1	1		
20 24" RLP OCTS OF PROJECT AR 20 30 Q4" RLP OCTS OON EXIST PIPE NO EXLESS 10 100 49" RLP ORS OON EXIST PIPE NO EXLESS 10 100 49" RLP ORS ON EXIST PIPE NO EXLESS	20 24" RLP 1010 EXIST PIPE NO EXCESS 10 100 49" RCF 106130 JOIN EXIST PIPE NO EXCESS 10 100 49" RCF 106130 JOIN EXIST PIPE NO EXCESS)	","			667/	1440	(EXISTING	10/5/00	EX197.	PONDING AREA SOUTH
20 24" REP 1010 EXIST PIPE NO EXCESS 10 49" REF 106150 JOIN EXIST PIPE NO EXCESS 10 100 49" REF 106150 JOIN EXIST PIPE NO EXCESS	20 24" RLP 101N EXIST PIPE NO EXCESS 10 100 49" RCF 106150 JOIN EXIST PIPE NO EXCESS 10 100 49" RCF 106150 JOIN EXIST PIPE NO EXCESS										WHICH IS OUTSIDE
20 24" RLP 101N EXIST PIPE NO EXCESS 10 100 49" RCF 106150 JOIN EXIST PIPE NO EXCESS PROVIDE FLAP GATE 10 100 49" RCF 106150 JOIN EXIST PIPE NO EXCESS	20 24" RLP GATE JOIN EXIST PIPE NO EXCESS 10 100 49" RCF 10659 JOIN EXIST PIPE NO EXCESS										PROJECT
20 24" RCP 1065180 101N EXIST PIPE NO EXCESS 10 100 49" RCF 106150 101N EXIST PIPE NO EXCESS 10 100 49" RCF 106150 101N EXIST PIPE NO EXCESS 1	30 24" RLP 1010 EXIST PIPE NO EXCESS 10 100 49" RCF 106150 JOIN EXIST PIPE NO EXCESS 1 PROVIDE FLAP GATE										
30 24" REP 1065180 101N EXIST PIPE NO EXCESS 10 100 49" REF 106150 101N EXIST PIPE NO EXCESS 101N EXIST PIPE NO EXCESS 1	30 24" REP 1065180 101N EXIST PIPE NO EXCESS 10 100 49" REF 106150 101N EXIST PIPE NO EXCESS 1 10 100 49" REF 106150 101N EXIST PIPE NO EXCESS 1										
10 100 49" RCF 106150 JOIN EXIST PIPE NO EXCESS 1	10 100 49" RCF 1061450 JOIN EXIST PIPE NO EXCESS I	1				NP.	30	24" RLP	1065780	1	Exeess
10 100 48" RCF 1068+30 JOIN EXIST PIPE ALD EXCESS	TO 100 48" RCF 1061+30 JOIN EXIST PIPE NO EYLESS							15140			1 1
PROVIDE FLAP GATE	PROVIDE FLAN	Ø				20	00/		1062+30	Exist	Ercess
									\cdot	PROVIDE FLAP GATE	

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

SUBANFA TOTAL SIDE-DRANAGE REGIN; LIEUTS RELIABRES NO Mark Size Decambe O Individual Decambridam STATION STATION RELIABRES NO SEC. S	PE	RTINE	N IN	ORMATIO	8	PERTINENT INFORMATION ON SIDE-DRAINA	GE INVESTIGATION -	Lower	SANTA ANA RIVER	K
NOTAL SIGNAM STATION STATION NEWBOUNDARY NEWBOUNDARY							214HT BANK			
# 1.			SUBAR	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
49 I 0.55 \$50 550 750 BxG' RCB 1066150 JOIN EXIST BOX NO 50 'K' 2.72 2500 4400 2400 20'x 11.5' RCB 105914 JOIN EXIST BOX. NO	4	NAME			O. C.F.S.	INDIVIDUAL Q CF.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
19 T 0.55 550 550 750 84.6' RCB 1066.50 JOIN EXIST BOX NO MO 2400 20'x 11.5' RCB 1059.44 JOIN EXIST BOX, NO										
60 "K" 2.72 2300 4400 2400 20'x 11.5" ROB 1059,4% 101M EKIST BOK, NO	49	Z		650	250	750		1066+50	Ex15T	NO EXCESS FLOW
50 "K" 272 2500 4400 2400 20'x 11.5' ROB 1059+94 10M Exist BOX, NO										
10 "K" 2.72 2300 4400 2400 20'x 11.5' RCB 1057+74 10M EXIST 130K, NO										
ON 151 X CO X (1/2) CO	Ş	Έ,			7					
				}	F		0.//	1057470	CKIST	NO EXCESS FLOW

81.F 173° 23 300 7067

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

L	PTAN	12	PERTINENT INFORMATION		ON SIDE-DRAM	MAGE INVESTIGATION -	10,00	402.70	10 00 00 00 00 00 00 00 00 00 00 00 00 0
								١	KIVER
						LEFT BANK			
		SUBAREA	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
2	MANE	\$1.2E \$4.71.	DISCHARGE PEAK C.F.S.	C.F.S	MENNOUAL 0 C.F.S.	DESCRIPTION	STATION	REMAKS	DISPOSITION OF EXCESS FLOW
,			J	7,7		1 1			
òi				760	200		1046+10	JOIN EXIST S4 "RCP	NO EXCESS FLOW
25					160	GO" RCP (PROPOSED)		PROVIDE OUTLET STRUCT.	
	",							FOR PROPOSED 60 RCP	
	27	0.6/	,009						
				•	,	0.0"		- [
76				04/	000	54 KCF	1037470	JOIN EXIST PIPE	No Ercess From
7.7				740					
22				200	000	(CX157.)	1029+20	JOIN EXIST 54" RCP	NO EXCESS FLOWS
						42" RCP (PROPOSEO)		PROVIDE OUTCET STR.	1
						BY CITY OF ANAMOIM		FOR PROPOSED 42"RCP	
	* ,								
8	67	0.48	640 {	\hat{w}	Ç0	556 PIPE	1021+9	REPLACE 12" 57L	NO EXCESS FLOW
						24" RGP (PROA)			
}				Ų	,			ļ	1
;				6	02	(0 "CMP	10/5+60	JOIN EXIST PIPE	NO EXCESS FLOW
							1		
56	·			08/	760	(4) - 48" RCP	1007+40	JOIN EXIST. PIPE	NO EXEESS FLOW
								INSTALL FLAP GATES	
77° s									

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

		DISPOSITION OF EXCESS FLOW		EX1585 F.O.S	}				Exects Flow			Excess Flow				
		DISPOSITI		3	L	0			ON	\downarrow		NO.				
		REMARKS	1 EXIST 12)-60.8CP	EXIST	15	PROPOSED ,			JOIN ESIST PIPES			N EXIST PIPE				
	1	STATION	W10/ 01+766	1	L.:	FOR	1		01 06+066			43450 JOIN	1	-		
LEFT BANK	SIDE-DRAMAGE REQUIREMENTS	DESCRIPTION	(2) - 60" RCP (ENST) 9.	36" RCP/EXIST)		•			(2) - 30" Crip qu			43° 20P 9				
	г	INDIVIDUAL 0 CF.S.	480						00/			160				
	TOTAL	0 R	440						60			00/				
	<u>ا</u> د	DISCHARGE PEAK C.F. S.							900					_		
) dy gr	NEW C	SI ZE 52. M.							0.44							
		NAME						4	14							
	DRAIN	皇	19					1	89		 	53			 	

1961 AL 22 'CIT 1:15

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

DISCHANGE REQUIREMENTS DISCHANGE OFFIX CES CES CES CES CES CES CES CE	NAME					RIGHT BANK			
MAME SITE FEATURE O INDIVIDUAL CES 2 CES	NAME	SUBAR	EA	TOTAL	•	SIDE-DRAINAGE REQUIREMENTS			
\$0 65 30° RCF 04055 JOIN EXIST PIPE NO EXCESS		SI ZE 50. M.		O. CFS		DESCRIPTION	STATION	REMARKS	8
\$0 65 30° ROF 1046150 101N EXIST PIPE NO EXCESS # 69-36" CNP U/F.G 1051150 101N EXIST PIPE NO EXCESS # 74 - 36" CNP 1050140 101N EXIST PIPE NO EXCESS # 74 - 36" CNP 1050140 101N EXIST PIPE NO EXCESS # 75 100 11" ROF 101405 101N EXIST PIPE NO EXCESS # 76 100 100 101 101 101 101 101 # 7 (4)-36" CNP 2/41/4 1995 101N EXIST PIPE NO EXCESS F # 7 (4)-36" CNP 2/41/4 1995 101N EXIST PIPE NO EXCESS F # 7 (4)-36" CNP 2/41/4 1995 101N EXIST PIPE NO EXCESS F # 7 (4)-36" CNP 2/41/4 1995 101N EXIST PIPE NO EXCESS F									
**	, o			30	65	1	1046150	EXIGT	NO EXCESS
*					Т	*			
# # (4)-36" CNP NOTES NO EXIST PIPE NO EXCESS. 1				*		"CNP"	103/130	EXIST	NO EXCESS
						NO18			
1	-			2		ana	_		
				*	*	- 36	-	EX157	NO EXCESS
# " 0,35 360 280 700 72" RCP 1019410 101N EXIST PIPE 100 10 50 55 36" RCP 1019405 101N EXIST PIPE 100 10 50 55 50 65 36" RCP 1019405 101N EXIST PIPE 100 10 10 10 10 10 10 10 10 10 10 10 10						W/F.G.			
# \$ 60 180 700 72" RCP 1019+10 101N EXIST PIPE 100 60 55 36" RCP 1019+05 101N EXIST PIPE 100 101 60 60 101N EXIST PIPE 100 101 60 60 101N EXIST PIPE 100 101N EXIST PI	*					(LOCATED IN RIVER)			
50 55 36" RCP (019+05 101N EXIST PIPE NO # (4)-36" CNP Sylants 979+50 101N EXIST PIPE NO ** (4)-36" CNP Sylants 979+50 101N EXIST PIPE NO	_	0.35	380	280	700	72" RCP	0146101	Ex157	NO EXCESS
50 55 36" RCP 109405 101N EXIST PIPE NO * * (4)-36" C11P 4/4181 979450 JOIN EXIST PIPE NO * * (4)-36" C11P 4/4181 979450 JOIN EXIST PIPE NO.	-					SPREADING			
# # (4)-36" CTP 1019405 101N EXIST PIPE NO ** (4)-36" CTP 3/41/11 97950 101N EXIST PIPE NO ** (4)-36" CTP 3/41/11 97950 101N EXIST PIPE NO									
# (4)-36" C+1P = 44184 979+50 JOIN EXIST PIPE NO.	*			20	55	36" RCP	50+6101	EXIST	ON
* * (4)-36" C11P WANTS 919450 JOIN EXIST PIPE NO EXCESS						SPREADING	(4)		
# * (4) -36" C+1P 3/41/2 979+50 JOIN EXIST PIPE NO EXCESS									
# # (4)-36" C+1P 2/41/81 979+50 JOIN EXIST PIPE NO EXCESS									
# # (4) - 36" C11P 3/418 979+50 JOIN EXIST PIPE NO EXCESS							1		
* (4)-36" CTIP W/4NEN 979+50 JOIN EXIST PIPE NO EXCESS									
(PIVERSION WORKS)	8			*	*	-36" CHP 3/61/81	979.50	EX/57	EXCESS
						VERSION WORKS)			
	ı		_		ı		-		

11.1 773° 28 14th 7007

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

E E	RTINE	NI IN	PERTINENT INFORMATION	8	SIDE-DRA	SIDE-DRAINAGE INVESTIGATION -	Lower	SANTA ANA RI	RIVER
						LEFT BANK	V		
1		SUBAREA	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
N D	NAME	SIZE 5A.M.	DISCHARGE PEAK C.F.S.	O. C.F.S.	INDIVIDUAL Q CF.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
66.				,	72/	000 400	470.7	1 1	3 1 1
)				9	76)	40 KCF	7/6+40	ייין אורב אורב אורב	NO EXCESS FLOW
,				,					
19				20	0,7	18° CMP	975+65	JOIN EXIST PIPE	NO EXCESS FLOW
68	.5%	0.63	9006	20	50	24 * RCP	970+60	JOIN EXIST PIPE	NO EXCESS FLOWS
,				•					
64				120	1250	INCEPCION (NOUNE)	365+85	JOIN EXIST BOX	NO Excess From
						יייייייייייייייייייייייייייייייייייייי			
20			-	80	00/	JWD " END	958+30	JOIN EXIST PIPE	NO EXCESS FLOW
									

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

1	2	N 1 INE		Orana III	5	SIDE-DR	PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION - Z	1026R	SANTA AND	RIVER
MAME 5172 OUCOUNDED STATION NEWWAYS DESCRIPTION Cat			SUBAR	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
10 35 24" CMP 955410 101N EXIST PIPE NO 110 1515 1715 NO 110 1515 1715 NO 110 1515 1715 NO 110 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 NO 1515 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 1715 NO 1715 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715 1715 NO 1715	\$ ₽		S1 2E 54.71.		o Si	1	DESCRIPTION	STATION	REMARKS	
C 0.56 120 42" CMP 965 +10 10M 64155 PIPE NO C 0.56 120 42" CMP 948 +5 10M 64155 PIPE NO C 150 150 42" R.C. PENS) 958 +65 10M 64155 PIPE NO C 150 54" R.C. PENS) 958 +50 10M 64157 PIPE NO C 150 54" R.C. PENS SED METALL 4001710 40 C 150 150 150 150 150 150 150 150 150 C 150										
20 35 24" CMP 965410 JOIN EXIST PIPE NO.										
16 26 24" CMP 966 +10 John Exist PIPE NO. 16 150 42" CMP 9466 John Exist PIPE NO. 16 150										
10 35 14" CMP 485410 JOIN EXIST PIPE NO 42" CMP 48465 JOIN EXIST PIPE NO 42" CMP 48465 JOIN EXIST PIPE NO 42" RCP FEVENS) 938165 JOIN EXIST PIPE NO 45" RCP FEVENS) 938165 JOIN EXIST PIPE NO 45" RCP FEVENS) 938165 JOIN EXIST PIPE NO 45 62" RCP FEVENS) 848450 JOIN EXIST PIPE NO 45 62" RCP FEVENS) 848450 JOIN EXIST PIPE NO 45 62" RCP FEVENS) 848450 JOIN EXIST PIPE NO 45 62" RCP FEVENS) 848450 JOIN EXIST PIPE NO 45 62" RCP FEVENS AND 45 64" RCP FEVENS AND 45 64" RCP FEVENS AND 45 64" RCP FEVENS AND 45 64" RCP FEVENS AND 45 64" RCP FEVENS AND 45 64" RCP FEVENS AND 45 64" RCP FEVENS AND 45 64" RCP FEVENS AND 45 64" RCP FEVENS AND 45 64 80 FEVENS AND 45 64 RCP FEVENS AND 45 64	i									
16 0.50 750 120 42" CMP 918465 101N EXIST PIPE NO. 16 150 42" RCP (EXIS) 938165 101N EXIST PIPE NO. 45 24" RCP (EXIST) 938165 101N EXIST PIPE NO. 460 200 54" RCP (EXIST) 918450 101N EXIST PIPE NO. 460 200 54" RCP (EXIST) 918450 101N EXIST PIPE NO. 5-64" RCP.	>				9	35		955+110		
	7.0				,					
"[6" 0.50 150 170 42" RCF (EXIS) 938165 60M EXIST. PIPE NO EXCESS 45" RCF (PROPOSE) 105744 4001710MAL 100 EXCESS 400 EXCESS 400 EXCESS 400 EXCESS 400 EXCESS 400 EXCESS 400 FONMAL 4001710MAL 400171	"				80	32/		948465	EXIBT	
16 0.50 150 (10 150 42" RCP (EXIST) 938165 101N EXIST. PIPE NO EXCESS 45		"/"	Ì							
10 150 42" RCP Exist) 938165 60.N EXIST. PIPE NO EXCESS 45 24" RCP PROPOSED 14" EXIST. PIPE NO EXCESS 450 200 54" RCP PROPOSED 10" EXIST. PIPE NO EXCESS 450 2-54" RCP PROPOSED 10" EXIST. PIPE NO EXCESS		97	0.20							
480 200 54" RCP (FRIST) 428+50 JOIN EXIST. PIPE NO EXCESS 480 200 54" RCP (FRIST) 428+50 JOIN EXIST. PIPE 400 2-54" RCP (FRIST) 428+50 JOIN EXIST.	20				170	02/	RCP	938165	JOIN EXIST. PIPE	Exeress
480 200 54" RCP (EXIST) 428+50 JOIN EXIST. PIPE NO EXCESS 400 2-54" RCP (PROPOSED) NATAL 4001710NAL 2-64" RCP.						30	Rep /		INSTAUL ADDITIONAL	
480 200 54" RCP (EXIST) 428+50 JOIN EXIST. PIPE NO EXCESS 400 2-54" RCP (PROPOSED) (NETALL 4001710NAL 6-64" RCP.									24" RCP.	
400 2-54"RCP (PROPOSED) (NOTAL 4001710NAL 2-64"RCP.	17				480	200	54" O(P (FX)47)	_	/A111 FULT 010E	600600
7-64" RC1						400	2-54" RCP (PROPOSED	2001	INCTALL GOOIFIONAL	242293
									2-64" RCP.	

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

						Rish! BANK	M		
		SUBAREA	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
PRAIN NO PR	NAME	SI ZE 58. M.	DISCHARGE PEAK C.F.S.	O. S. S.	INDIVIDUAL Q CFS.	DESCRIPTION	STATION	MEMARKS	DISPOSITION OF EXCESS FLOW
72	*N/C	0.37	0/9	2/0	*	(4) - 36" RCP	916125	JOIN EXIS	NO EXCESS FLOW
				,		in/ GATES		DIVERSION NORKS	
_						YOIVERSION BORKS		TO THE SPREADING	
								0	
_									
		_							
-									

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

Ē	RTINE	N IN	PERTINENT INFORMATION ON SIDE-DRAINAC	80 2	SIDE-DRA	SE INVESTIGATION -	LOWER	SANTA ANA RIN	RIVER.
						LEFF BANK			
		SUBAREA		TOTAL		SIDE-DRAINAGE REQUIREMENTS			
ND NO	HAME	\$1 2E 50. M.	DISCHARGE FEAK C.F.S.	O CFS	HENTOUAL 0 CFS.	DESCRIPTION	STATION	REMANKS	DISPOSITION OF EXCESS FLOW
22				200	200	60,000	574976	JOIN EXIST PIPE	NO EXCESS FLOW
								ı	
29				40	20	36" RCP	973+75	JOIN EXIST PIPE	NO EXCESS FLOW
`				}					
78				6		000 101	00700	1777	
)				3	/3	ום צרג	CD 1674	שוא באוטי דודם	M 645633 75080
99	1/7	15.0	22						
`		Š) 	200	300	~ }	307+85	JOIN EXIST PIPES	NO EXCESS FLOW
			-			w/ r. G.			
٠									
80				140	200		898400	JOIN EXIST PIPES	No Excess Flow
						W/ FDAP GATES			
2				270	270	60" RCP	01+1/8	JOIN EXIST PIPE	NO EXCESS FLOW
-			•				1		
- 100 T									

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

STATION STATION SHATES CARBON CANYON CHANNEL CONFLUANCE STRUCTURE STRUCTURE STRUCTURE STRUCTURE NO EXCESS FL PONO PONO SEA445 JOIN EXIST PIPE NO EXCESS FL PONO DON EXIST PIPE NO EXCESS FL SISTRO JOIN EXIST PIPE NO EXCESS FL TO ALO SUDE CATE TO ALO AND ANY FL TO ENTER FLOW W TO ALO ANY FL TO ENTER FLOW W TO ALO ANY FL TO ENTER FLOW W TO ALO ANY FLOW W TO ALO							RIGHT BANK			
11.1			SUBAR		TOTAL		SIDE-DRAMAGE REQUIREMENTS			
"M" 3.80 5300 5500 TRAP. CHANNEL B4615 CA (CARBON CANYON) CHAN CHA STA 30" CMP W/F.G 30" CMP W/F.G 30" CMP W/F.G 40" CMP W/F.G (ONVERSION WORKS) CHAN (ONVERSION CHAN (ONVERS	뎣	N N			c c s	C.S.	DESCRIPTION	STATION	REMANCS	8
*** \$.80 \$5.00 TRAP. CHANNEL 346425 CA (LOK ROW CANYOW) STR *** *** *** *** *** *** *** *** ***							!			
MI 5.80 5500 (CORROW CANYON) CHA STA ** DIVERSION WORKS 84446 ** (4) - 30" CMP WISTERS 84446 ** (4) - 30" CMP WISTERS 84446 ** (7) - 36" CMP WISTERS 813480 ** (7) - 36" CMP WISTERS 813480 ** (7) - 36" CMP WISTERS 813480 ** (7) - 36" CMP WISTERS 813480 ** (7) - 36" CMP WISTERS 813480 ** (8) - 36" CMP WISTERS 813480 **		•			5300	5500		846+25	L	
00° 0.05 - * \$146R510M WORUS 844.45 30" CMP WJ68'E 813.430 - * (2) - 30" CMP WJ68'E 813.400 - * (2) - 30" CMP WJ68'E 813.400 - * (2) - 30" CMP WJ68'E 813.400 - * (2) - 30" CMP WJ68'E 813.4000 - * (2) - 30" CMP WJ68'E 813.4000 - * (2) - 30" CMP WJ68'E 813.4000 - * (2) - 30" CMP WJ68'E 813.4000 - * (2) - 30" CMP WJ68'E 813.4000 - * (2) - 30" CMP WJ68'E 813.4000 - * (2) - 30" CMP WJ68'E 813.4000 - * (2) - 30" CMP WJ68'E 813.4000 - * (2) - 30" CMP WJ68'E 813.4000 - *	Pg	È	3,80	5300			7		CHANNEL	
"00p" 0.05 " * * * * * * * * * * * * * * * * * *	-								STRUCTURE	
000 0.05										
00° 0.05 - * * * * * * * * * * * * * * * * * *										
00° 0.05	,									
00° 0.05	B				1	*	DIVERSION WORKS	844.48	JOIN EXIST	NO EXCESS FLOW
000 0.05							36" CMP W/ F.G			TRAIN TO SPECIOUS ACTION
000 0.05	Ġ									
000 0.05 ** (7) - 36 ** CMP J/64 ** 813+80 (010 = 8510 M DORKS)	20				{	*	1	844+25	JOIN EKIST	EKCESS
000 0.05 4 (2) - 36" CMP JENTE 813+80 (010 ERSION WORKS) (14 14 65 42" RCP WIFE 109+00 AND 48" RCP WIFE (PRO) 109+00 AND										
00P 0.05 - # (2) - 36" CMP J64TE 813+80 (DIVERSION WORKS) 114 114 65 42" RCP WJFG 709+00 100	_	•	· ·							
114 114 65 42" RCP 2/64TE 813+80 114 114 65 42" RCP 2/FG 709+20 100		900	0.05							
114 114 65 42" RCP WIFG [09+00 400	Ø1				{	ŀ		812+20	JOIN EXIST PIPE	616655
114 114 65 42" RCP 21 FG 109+60 100 100 100 100 100 100 100 100 100 1)			20.77	30179	
114 114 65 42" RCP W/FG [PROF] 109+00 400	9								1 1	
48" RCP 2/76 (PROP) 709+00 400	00		=	#	4/	65	42" RCP w/FG	709+10		men cory system
Wed Law							1000	109+00	400	BE CONTAINED IN THE
	884								ROA	POND, SEE DUG 18
	7:18	-	rek	RECH.	ore			en DR.	(MA	
WATER RECHARGE BASINS (NO LOCAL STORM DRAIN)										

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

Ľ							,	,	746E 46 0F 37
	KIN		CHAMALIC	5	SDE-DKA	PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION = 2	100ER	SANJA HNA KI	RIVER
						LEFT BANK			
		SUBAREA	EA	TOTAL		SIDE-DRANAGE REQUIREMENTS			
1 2	MANE	SI ZE 54. M.	DISCHARGE PEAK C.F.S.	C.S.	INDIVIDUAL Q CF.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
89	•			23	90	30" RCP	805+35	JOIN EXIST PIPE	NO Excess FLOW
8				w w	00/	32" CMP	56+661	JOIN EXIST PIPE	NO EXCESS FLOW
10	<u>"</u> Q	1.62	008/	44	09/	42" RCP	797+40	JOIN EXIST PIPE	NO EKCESS FLOW
77			<u>.</u>	002/	008/	(2) 1'x7' RCB	30+881	JOIN EXIST BOX	NO EXCESS FLOW
80	<i>D</i> ,	0.32	400	400	400	66°RCP	763+50	JOIN EXIST PIPE	NO EXCESS FLOW
j									
4/	1 "000"	0.0/	20	9	3/	24" CMP	850120	JOIN EXIST. PIPE	NO EXCESS FLOW
						PRAIN FOR GRAVEL			
		<u></u>							
	4								
z 'CT									

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

						LEFT BANK	V		
		SUBAREA	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
	NAME	51.2E 50.7/1.	DESCHANGE PEAK C.F.S.	CFS	INDIVIDUAL 0 CFS.	DESCRIPTION	STATION	PERMINS	DISPOSITION OF EXCESS FLOW
			*						
95				e	6.5	16" CMP	749+75	JOIN EXIST PIPE	NO EXCESS ROW
,								ADD FLAP GATE	
- (
2				34	160	54" RCP	5/48/2	JOIN EXIST PIPE	NO EXOESS FLOW
							1		
Ş	11				٩	200 20			1
>		0.39	200	00/	90	42 KCP	740+35	JOIN EXIST PIPE	NO EXCESS FLOWS
·							1		
4				,		17.			
9			•	0	40	ACP	724+80	JOIN EXIST PIPE	NO EXCESS FLOW
						FORCE MAIN FROM			
						PUMP STATION)			
•				•					
79				\$	40	27" KCP	7/0+00	JOIN EXIST PIPE	NO EXCESS FLOW
			_			13/ FLAP GATE			
						,			
							·		
								-	-
ŀ									

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

SUBAREA TOTAL SIDE-DRANAGE R SI ZE FEAK OF S. CFS. OF S. S.O.M. CFS. OF S. L.03 /400 /400 /400 /2 05 S	MAME 512 CES CES CES DESCRIPTION STATION RELIABRES DESCRIPTION STATION RELIABRES DESCRIPTION STATION RELIABRES TO 100 CESCULION STATION RELIABRES TO 100 CESCULION STATION RELIABRES TO 100 CESCULION STATION STATION RELIABRES SASIN (NO LOCAL STORM DEANN)	2	RTINE		ORMATIO	8	SIDE-DR	PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION - A RIGHT BANK	LOUER	SONTA ANA	RIVER
Size Per C.F.S. C.F.S. C.F.S. DESCRIPTION STATION REMANS DEPOSITION SIZE PER C.F.S. C.F.S. C.F.S. TATARON DESCRIPTION STATION REMANS DEPOSITION DESCRIPTION DESCRI	11.0 F 1400 1400 12 12 12 12 12 12 12			SUBAR	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
1,05 1400 1400 1400 11 x 9,5' R C B 74749 DISCHARGE TO 100 EXTESS. R A S (1), R A S (1),	LOS 1400 1400 16×95' RCB 74749 DISCHARGE TO NO EXCESS. SPECTORNO GROUND SATER HARGE SASIN (NO LOCAL STORN DRAIN)	MAN DE	NAME		DISCHANCE PEAK C.F.S.	o S.		DESCRIPTION		REMARKS	
1.05 1400 1400 12 x 9.5' RCB 14749 DISCHARGE TO NO ETTESS. 5PREADING GROWN BASIN.	LOS 1400 1400 16 x 9.5 RCB 74740 DISCHARGE TO 10 EXCESS RASIN, RASIN, RE FOR OWN GROUND SATER HARES SASIN (NO LOCAL STORM DRAIN)										
1,03 1400 1400 12 x 95' RCB 747.90 DISCHARGE TO 100 EKEESS 1800 100 EKEESS 1800 100 EKEESS 1800 100 EKEESS 1800 100 EKEESS 1800 100 EKEESS 1800 100 EKEESS 1800 100 EKEESS 1800 100 EKEESS 1800 1800 EKEESS 1800 1800 1800 1800 1800 1800 1800 18	1.05 1400 1400 112 x 9.5' RCB 7479 DISCHARGE TO 100 EXCESS \$96,6500,000 000 0000 00000 00000000000000							+			
\$45/W. \$45/W.	VE TOR OCND GROUND SATER HARGE BASIN (NO LOCAL STORN JRAIN)	00/	0,	2.03		1400	1400	18 x 9.51	747.490		67.02.64
11.11.11.11.11.11.11.11.11.11.11.11.11.	WYAKE FOR OCWD GROUND SATER RECHARGE BASIN (NO LOCAL STORM DRAIN)						L				
	WTAKE FOR OCNO GROUND VATER RECHARGE SASIN (NO LOCAL STORM DRAIN)										
	WTAKE FOR OCNO GROUND RECHARGE SASIN (NO LOCAL										
	WTAKE FOR OCNO GROUND RECHARGE SASIN (NO LOCAL										
	WTAKE FOR OCNO AROUND RECHARGE SASIN (NO LOCAL										
	WTAKE FOR OCNO GROUND RECHARGE SASIN (NO LOCAL										
	WTAKE FOR OCNO GROUND RECHARGE SASIN (NO LOCAL										
	WTAKE FOR OCNO GROUND RECHARGE SASIN (NO LOCAL										
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	WTAKE FOR OCNO GROUND RECHARGE SASIN (NO LOCAL										
	WTAKE FOR OCNO GROUND RECHARGE SASIN (NO LOCAL										
	WTAKE FOR OCNO GROUND RECHARGE SASIN (NO LOCAL								1		
	WTAKE FOR OCNO GROUND RECHARGE SASIN (NO LOCAL										
	WIAKE FOR OCND GROUND RECHARGE SASIN (NO LOCAL	_									
	INTAKÉ FOR OCNO GROUND RECHARGE BASIN (NO LOCAL										

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

STATION OF EXCESS FLOW
ALLON CANA TOUR MOL CIERT
PUTLET TO SANTA ANA
RIVER FROM 18451
688 160 JOIN EXIST PIPE NO EXCESS FLOWS
686750 JOIN EXIST. PIPE NO EXCESS
0000 3708M

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

PE	RTINE	Z Z	ORMATIC	8	PERTINENT INFORMATION ON SIDE-DRAIN	AGE INVESTIGATION -	LOWER R	SONTA AND RIVER	
		SUBAREA	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
DRAIN	NAME	S12E 50.11.	DISCHARGE PEAK C.F. S.	7	INDIVIDUAL Q CF.S.	DESCRIPTION	STATION	PEMARKS	DISPOSITION OF EXCESS FLOW
901				8	140	48"RCP W/ F.G	69510	JOIN EXIST PIPE	CO13 5937X3 ON
100				70	38	24.800	682+70	JOIN EXIST PIPE	NO EXCESS FLOW
107	17,	85%	310	10	310	48"RCP W/ F.G.	01+699	BOIN EXIST PIPE	MOTH 888217 ON
80)				9	011	48" RCP	659+00	ION EXIST PIPE	No EX 1855 FLOW
601				0	14	du2 n81	654+40	101N E	NO EXCESS FLOW
0//	"T"	£9'/	1400	1400	2100	(2) 12'x9' RCB TRAP CHONNEL	628160	JOIN EXIST. BOX TIE BACK RIER LEVEE TO BITTERBUSH CHANNEL	NO EXCESS FLOW

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

1 1 1 1 1 1 1 1 1 1	-	Z INC	2	PERTINENT INFORMATION ON SIDE-DRAINA	3	SIDE-DR	GE INVESTIGATION -	LOWER	SANTA AND KIYER	Ęĸ
MAME 51.7E PERM OF GROWN STATION REMANS DISCORPTION OF EXCESS OF SIGNATURE OF STATION OF EXCESS OF SIGNATURE			SUBAR	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
"V" 0.56 620 400 750 (3) 5'x5' RCB 625+15 1010 Exist Box NO Excess: 180 760 770 2'x3' RCB 021+10 1010 Exist Box NO Excess: 20 20 4 24" CNP 605+10 1010 Exist Box NO Excess: 20 20 4 24" CNP 605+10 1010 Exist Box NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 4 24" CNP 605+10 1010 Exist PIPE NO Excess: 20 20 5 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	MA	NAME				INDIVIDUAL Q C.F.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
"V" 0.56 620 400 750 (8) 5'x5' RCB 625+55 10M EXIST BOX NO EXCESS 1 (So 380 76) 2'x3' RCB 4/RG 621+10 101M EXIST BOX NO EXCESS 1 20 20 4 24" CMP 605+10 101M EXIST PIPE NO EXCESS 1	*				2	9//		675190	EX197	111
20 20 4 24 "CHP 605110 JOIN EVIST BOX NO EXCESS 1	211	1/4		_	400	150	18481	55+529	EXIST	1 1 1
20 20 # 24 CMP 605110 JOIN EXIST PIPE NO EXCESS	13	- " "			130	380	878, 878		E1167	1 1 1
	1/4				20	02		005110	Ex157	1 1 1

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

15 1 2.61 16.00 160 16.00		ERT	NEN	<u> </u>	DRMATIO	8	SIDE-DRA	PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION - \angle	LOWER	SANTA ANA RIVER	ķ
MAME 517E PART PA		Ц		SUBARE	Y:	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
"1" [.6] (400 (600 60 x 1" RCB (Exist) 648440 101N EXIST BOX (FICESS OF BOLLOB) 101N EXIST BOX (FICESS OF BOLLOB) 101N EXIST BOX (FICESS OF BOLLOB) 101N EXIST BOX (FICESS OF BOLLOB) 101N EXIST PIPE 101E 101N EXIST PIPE 101N	2 3	2			DISCHARGE PEAK C.F. S.	o CF.S		DESCRIPTION	STATION	PEMARKS	DISPOSITION OF EXCESS FLOW
11" 2.61 1600 1600 10'41" RCB (Exist) 64340 JOIN £1157 BOX Ê10555 24. RCP (1800060) 640-00 14' X24' C.B. G 10		-	-								
10 2.61 1600 1600 10 × 11 × 12 × 12 × 12 × 12 × 12 × 12				,				0.0		1	ļ
	<u>"</u>	7 / 6		19:2	009	1600	600	٤١٥	643140	N EX/57	EXCESS FLOW WILL
	15,	_						T	001010	18	To THE IN BUILT
50 50 50 CMP 627410 JOHN EALOS ATHIOS				-						CARRY EXCESS OF 30LR	OF CHOPMAN AVE
50 56 (2) 30° CMP (27410 101N EXIST PIPE NO E. 1118046A 118046A 12										1	BRIDGE, PROVIDE
50 56 (2) 30° CMP (27410 JOIN EXIST PIPE NO EXIST PIPE NO EXISTS 1010 EXIST PIPE NO EXISTS 1010 EXISTS 101				-							C.B. & PIPE CONNEC.
50 50 50° CMP 627410 JOIN EXIST PIPE NO EAG 10											7.
"W" 0.16 230 FG (2) 30° CMP (227+10 JOIN EXIST PIPE "W" 0.16 230 Bo 40 42" CMP W/RG 610+60 MANDE PARMA AKEA WY 0.16 230 Bo 40 42" CMP W/RG 610+60 JOIN EXIST PIPE LO 10 10 10 10 10 10 10 10 10 10 10 10 10		\dashv	1								4 THIS POINT.
10	<i>"</i> "	L.				١				1 1	
10 0.16 230 80 30 42" CHP W/RG 620-60 HOWNE FORDING AREA 10	<u> </u>					20	20	(2) 30°CMP	627+10	- 1	NO EXCESS FLOW
"W 0.16 230 80 40 42" CMP W/RG 610+60 MSTALL 36" RCP W/F.G 10 40 42" RCP (PROP) 618+20 MSTALL 36" RCP W/F.G 20 40 42" RCP K/F.G. 607+10 JOIN EXIST. PIPE 20 10 10 10 K/F.G. 607+10 JOIN EXIST. PIPE 36" CMP W/F.G 607+10 JOIN EXIST. PIPE 36" CMP (PROP) SROWING PREM								\ 		•	
UN 0.16 230 80 40 42" CMP W/FG 610+60 MSTALL 36" RCP U/F.G 104 40 42" RCP K/F.G. 607+10 JOIN EXIST. PIDE 20 40 14" RMP K/F.G. 607+10 JOIN EXIST. PIDE 20 40 24" RMP K/F.G. 607+10 JOIN EXIST. PIDE 36" CMP (PROP) PROVING PREN	,					•					Excess Flow will
UN 0.16 230 80 40 42" R.CP (PROP) 618120 MSTALL 36" R.CP W/F.G. 607+10 JOIN EXIST. PIDE 20 10 14" (MP N/F.G 607+10 JOIN EXIST. PIDE 36" CMP (PROP) PROVINE PANDING AREA E 36" R.CP DRAIN			_;			80	30	CMP W/RG	620160	PROWIDE PONDING AREA	RE CONTAINED IN THE
20 40 42" RLP WIFG. GOTATO JOIN EXIST. PIDE 20 10 14" CMP WIF.G GOTATO JOIN EXIST. PIPE 36" CMP (PROP). \$50" RCP DRAIN	<u> </u>	<u> </u>		0.16	230			KCP (PROP)		, ,	PONO SEE GNT. El
20 LP 24 CMP W/F.G GOTHO JOIN EXIST, PIPE 36"CMP (PROP) PROVIDE POWON'S AREA	2					80	40	40" 119 11/50	607.10	JOIN FILST. PIDE	EVER ELL ELOES LAW AS
LO LO LO VIEG GOTHO JOIN EXIST. PIPE : 36"CHP (PROP). PROVING PREM						<u> </u>				PROVIDE PONDING APEA	LONTAINED INTHE PON
LO LO LA CHP WIG GOTHO JOIN EXIST. PIPE 36"CHP (PROP) PROVIDE PONDING AREA L						,		1			586 DWG 22.
36" CHP (PROP) PROVIDE PONDING AREA L	1		_			10	42	2/1.6	01+100	JOIN EXIST. PIPE	EXCESS Flow whe RE
\$ 36" RCP DRAIN POND. SEE DWG	119	0			<i>-</i> -			(402)		DNIONOS	CONTRINED IN THE
		-	7							E 36" ACP DRAIN	PONO. SEE DWG 22
					ļ						

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

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	H	RTINE	NT IN	PERTINENT INFORMATION ON	8 2	SIDE-DRA	SIDE-DRAINAGE INVESTIGATION	Lower	SANTA ANA RIVER	
12 W 0, 190 So So So So So So So S							RIGHT BANK			
			SUBAR	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
20	2	NAME			C.F.S.		DESCRIPTION	STATION	PENAPIKS	DISPOSITION OF EXCESS FLOW
2 W 0,11 190 80 120 36" RCP W/150 1010 E1157 PIPE NO E11855 22 W 0,11 190 80 190 54" RCP W/FG 58720 1010 E1157 PIPE NO E11855 23 50 30" RCP 885720 1010 E1157 PIPE NO E11859	120				40	0//	36" RCP	57+009	EX167	EXCE\$5
2 40 120 36" RCP 40+30 540 Exist Pipe 100 Exists 120 1									1	
122 111 190 80 190 54" RCP W F.G 683+26	1				1					
122 WU 0.11 190 80 190 54" RCP W F.G 583+20 JOIN EXIST DIPE NO EXCESS 1					40	07,		120 + 30	PROVIDE FIAP GATE	
	100	•			•					
123 So 50 Marso loin Exist Pipe NO Excess	77/		0.11	061	2	190	W/F.G	583+20	EX157	EXCESS
163 So SO NOT RCP 1881-30 101N EUST 110E NO EXCESS										
20 30 30 30 W. K.C.F. 783530 10/N Exters5	183				-	,	9	700		
					00	36	KCF	765430	EX151	EXCESS
	-									
	-									

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

SIBAPEA TOTAL SIDE-DAJANGE REQUIRERTS REMANS ORFOGITOR OF EXCESS FLOW	SUBMER A TOTAL SIDE-DRAMME REQUIREMENTS REMAINS DISPOSITION OF EXCELLENCE FOR A STATION STATION STATION OF EXCELLENCE FOR A STATION OF EXCELLE	S122 DECLARA 1 SEC-DAMME REQUIREMTS S122 PEAM CAS CAS CAS CAS CAS CAS CAS CAS CAS CAS	W	RTINE	N IN	PERTINENT INFORMATION ON SIDE-DRAINA	8	SIDE-DRA	GE INVESTIGATION -	LOWER	SANTA ANA RIVER	8
STEAM STOTAL STOCK-COANDAGE RECOMPLISHENTS STATION STATI	SIZE NEAM CES GES GESCHIPTION STATION REMANS DISPOSITION OF EXCEPTION	STATE CALL							LEFT BANK			
12 12 12 12 13 13 13 13	SIZE CES. CES. CES. CES. CES. CES. CES. CES	13.12 DECEMBER 0 WEARING BEAUTION STATION OF EACH SAME OF STATION OF STATI			SUBAR		TOTAL		SIDE-DRAMAGE REQUIREMENTS			
112	1104 40 43 28 36 4CF (FRANSED) 5614-50 PROVIDE ADDITIONAL NO ELECTION 100 ADDITIONAL NO ELECTION 100 ADDITIONAL NO ELECTION 100 ADDITIONAL NO ELECTION 100 ADDITIONAL NO ELECTION 100 ADDITIONAL NO ELECTIONAL CREEK NO ELECTIONAL CONTINUES CREEK NO ELECTIONAL CONTINUES CREEK NO ELECTIONAL CONTINUES CREEK NO ELECTIONAL CONTINUES CREEK NO ELECTIONAL CONTINUES CREEK NO ELECTIONAL CONTINUES CREEK NO ELECTIONAL CONTINUES CREEK NO ELECTIONAL CONTINUES CONTINUES CREEK NO ELECTIONAL CONTINUES CREEK NO ELECTIONAL CONTINUES	12		NAME		448	O. C.F.S.		DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
110.4 40 43 28 24 4CP (FRANSO) 36 4CP M/FG LS 36 4CP M/FG LS 36 4CP (FRANSO) 36 4CP M/FG LS 36 4CP M/FG LS 36 4CP M/FG SECURITION SOUTHWELE SOUTHWEE CHANNEL SONTINGO CREEK NO STEESS STRUCTURES TRANSCOCKES STRUCTURES TRANSCOCKES STRUCTURES	1104 90 95 28 24" RCP (FRONSED) 36" RCP W/ RCD LS 36" RCP W/ RCD S6" RCP W/ RCD RCP W/	1104 40 45 28 24 4CP (PROPSED) 36 4CP 4/ FG 65 36 4CP 4/ FG 107.1 Sov Sive Standing CRESK NU SICESO CHANNEL CHESK NU SICESO CHANNEL CHESK NU SICESO CHANNEL CHESK NU SICESO CHANNEL CHESK NU SICESO CHANNEL CHESK CHESK CHESK CHANNEL CHESK CHES	1								JOIN EXIST. PIPE	
18.1 Swo Swo Trop. Channel Stills Santuses Creek NV Brees (Santiago Creek) Staucture (Santiago Creek) Staucture	M. Sav IND SC C M	111.1 Sino Sino Tear. Channel Storo Edutida Cresk No SICESS (SANTINGO CREEK) STOLOTURE (SANTINGO CREEK) STOLOTURE	4	1/1/4	0.04	8	93	87	(EX157)	05+889	PROVIDE GOOTHONGE	No Excesso
W.1 Sow IND Soco TEAP. CHANNEL SIGNO GANTIAGO CREEK NO ENCESO (SANTIAGO CREEK) (HANNEL GANFLIANCE) STRUCTURE	18.1 Swo Swo Trap. Channel Biblio Gantideo Creek No Biless (Santideo Creek) Channel Onflues (Staucture)	18.1 Sav Sav Teap Channel Bistod Santingo Creek IN BILEGO (HANNEL CHAN						99	36" RCP (PROPSED)		36" RCP W/FG	
111.1 Savo Sino TRAP. CHANNEL BUSTAGO CREEK NU EXCESS	111.1 Sow Sow TROP. CHANNEL SIGNO SANTIAGO CREEK NO EXCESS (SANTIAGO CREEK) (SANTI	116.7 Soo Soo Tear Channel Signo Carthas Creek No by Brees										
Sou TRAP. CHANNEL SIGNO SANTIAGO CREEK NO BICESS STRUCTURE STRUCTURE	M.1 Sow fin 5000 TRAP. CHANNEL SIGNO SANTIAGO CREEK NO EICESS STRUCTURE STRUCTURE	W.1 Soo Soo Teop Channel Signo Greek NV BYCESS (SANTIAGO CREEK) (SANTIAGO CREEK) STRUCTURE		·								
MIT SOUD TRAP. CHANNEL STANTAGO CREEK NO ELCESS STRUCTURE STRUCTURE	18.7 Sovo TRAP. CHANNEL SIGNO SANTIGAD CREEK NV BICESSS (SANTIAGO CREEK) (HANNEL CHANN	18.1 Sow fin 5000 TRAP. CHANNEL STORE SANTIAGO CRESK NV SILESSS (SANTIAGO CRESK) (SANTIAGO										
MI.) Spar fin 5000 TRAP. CHANNEL SHOTIAGO CREEK NO ENCESSO (YANNEL CONFLIANCE) SANTIAGO CREEK)	MIT SIND SIND TRAP. CHANNEL STORD CREEK NV BYCESS	MIT FIND FOOD TRAP. CHANNEL STATINGO CREEK NV SILESSON (SANTIAGO CREEK) (SANTIAGO		١								
(SANTAGO CREEK) CHANNEL CONFLUANCE 578 LACTURE 1.	(SANTIAGO CREEK) CHANNEL CONFLUANCE STRUCTURE	(SANTIAGO CREEK) CHANNEL CONFLUANCE 578.UCTURE	S	1	_	ands	ones		TRAP. CHANNEL	566100	ı	EXCESS
57&ucTue	57&ucTue	\$72WCTUR							(GANTIAGO CREEK)		CHANNEL CONFLUANCE	
											STRUCTURE	
			_									
				_								
			-									

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

								PAGE	PAGE 32 OF 39
PE	RTINE	NT IN	ORMATIO	30 Z	SIDE-DRA	PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION - LOWER	28 Ma;	SANTA ANA RIVER	3
						RIGHT BANK	IV.		
4		SUBAREA	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
ğ	NAME	SIZE Se.n/	DISCHARGE PEAK C.F. S.	c S	INDIVIDUAL O CFS.	DESCRIPTION	STATION	REMADKS	DISPOSITION OF EXCESS FLOW
777				001	160	48" RCP	281 099	JOIN EXIST. PIPE	NO EXCESS FLOW
	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	100							
	<u> </u>	10:01	06/						
127				64	57	30" RCP W/EG	254.10	JOIN EXIST. PIPE	EXCESS F10W
							ì		40
				*					WIMIN THE STRETS
									526 Dug 23.
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	•								
_									
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TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

								,	PAGE	33 00 39
PER	THEN	1	ORMATIO	NO N	PERTIMENT INFORMATION ON SIDE-DRAMA	GE INVESTIGATION -	lower	SONTA ANA	RIVER	
						RIGHT BANK	2			
Ne Ann		SUBAREA	Y.	TOTAL		SIDE-DRAMAGE REQUIREMENTS				
	NAME	\$12E \$4.M.	DECHARGE PEAK C.F.S.	650	MDNYDUAL OF S.	DESCRIPTION	STATION	REMARKS	,	DISPOSITION OF EXCESS FLOW
128	MVS	0.11	66	9,6	44	36" CHP	536+65	JOIN EXIST ,	3010	NO EXCESS FLOW
62/				9.9	9//	56° RCP W156	528.40	IVIN EXIST PIPE	3010	NO EXCESS FIOM
06/				8	130	36" RCP	522+40	JOIN FX167	3010	NO EXCESS FLOW
13/	***	2%	400	280	067	69" RCP	509+35	JOIN EXIST P	5014	NO EXCESS FLOW
135				3	140	36" RCP W/F.G	498135	JOIN EXIST P.	30/10	NO EXCESS FLOW
		\exists								
···										

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

2			PERTINENT INTORNATION ON SIDE-DRAIN	5	SDE-DR	LEFT BANK	SONER	SANTA ANA RIVER	8
		SUBAREA	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
M di	NAME	SI ZE 68.M,	DISCHARGE PEAK C.F.S.	O. C.F.S.	INDIVIDUAL Q CFS.	MOLLIBOSSO	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
123				00/	00	040,000	0.122		
:				<u>}</u>				ADD FLAP GATE	CONTAINED IN THE
								} }	POND. SEE DUG 23
401									
				120	180	58 x 36" ARCH	534755	JOIN EXIST. PIPE	NO EXCESS FLOW
120	7	,		30	38	92" RCP	687.10	7019 EXIST 010E	NO Frokk Exo
3	2//	1.21	1040						
187				,	,				
90/				40	00	20" KCF	254:40	JOIN EXIST PIPE	NO ERCESS FLOW
137				750	250	(3) 48" RCP W/ F.G	523+10	JOIN EXIST PIPE	NO EXCESS FLOW
			.,						

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

MAME 5172 PERMINE O MENUDAL DESCRIPTION STATION RELIAMS DIRECTOR OF EXCENSION OF EX	MUME SIZE DISCULARE O HONDULAL GES. CES. CES. CES. WW3 0.85 750 750 750 7700	LEFT BANK		
WYS 0.85 750 750 1700 (2) 10x5-1° ECB 508465 10M ENGT 804 NO ENGESS WHO IDD 100 150 48° ECP 46040 10M ENGT 1106 NO ENGESS WHO IDD 100 100 100 100 100 100 100 100 100 1	WV3 0.85 750 750 1700 100 1200	STATION	ENAMES	DISPOSITION OF EXCESS FLOW
WIG 100 100 150 48° RCP 499.00 101N ENIST 1118 NO ENISES	100 100 240 100 100 240	508165	EX165	NO FILESS FLOW
WIG 100 100 150 48° RCP 4900 101N EXIST 1198 NO EXISTS	200 (00) (100 (200) (100			
		NOI	S414 T21X3	1 1 1

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

	ERTIN	ENT IN	FORMATIO	8	SIDE-DRA	PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION -	loure.	SONT DNA PINED	1 NGC 30 OF 39
						13			Ą
	Ц	SUBAREA	κEA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
इ इ	HANE	E SIZE 58.71.	DISCHANGE PEAK C.F. S.	0 CFS	INDIVIDUAL Q CF.S.	}	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
4	140 WW	7. 0.05	00	09	20	1 10 1	99+70		NO EXCESS FLOW
						(Jaxi) Jax 47	\prod	24" RCP	
				-					
4	_			75	91	1.6	353+65	10W EXIST PIPES	NO EXPESS FIRES
	`\ <u>\</u>	0.59	380			П		MA	
142			}	305	380	60" RCP W/ F.G 3.	352+40	JOIN EXIST PIPE	NO EXCESS FLOW
			-						
	***				T				
							†		
	-								
				1			1		
*CIT *									

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TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

14				PERTINENT INTORMATION ON SIDE-DRAIN	5	SUE-UK	KIGHT BAN	LUWCK	SANIA ANA KIVEK	
### 5122 PREMISE OF HONOROM PROPERTIES PROPERTIES \$41.81, CES CES CES CES CES CES CES CES CES \$41.82 CES CES CES CES CES CES CES CES CES CES CES CES CES \$75 CES			SUBAR	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
16 16 14" 16" 100 10 10 10 10 10 10	g g				O. CFS	DIMDUAL 0 0	DESCRIPTION	STATION	REMARKS	
18 16 16 124' 12 12 12 12 12 12 12 1										
13 140 515					9/	91	\sim	208+10	EX167	1
50 170	143	72		2/2			. 1			748
500 50 50 80 80 80 80 80	£.	2	04/0	0/0			FROM EDISON CO. YARD)			FLOW WILL BEDIVER
500 5 36" RCP W F.G. 16910 1010 EXIST. PIPE										TO TAUSER CHANN
500 5)-56 RLP W F.G. 16910 1010 Exters 10 Exters 10 Exters 150 000 G/M 10 10 10 10 10 10 10 1										
500 53-56 RLP W R.G. 19410 1010 Exist. PIPE NO EXCESS. 1860 18410 1960 1860										
X2 0.78 500 (5)-56, 120 m/ 6.6 M9410 JOIN Extest. PIPE NO Extests X2 0.78 510 56, 120 m/ 54 m/ 6.6 M9410 1010 52.30 m/ 6.6 m/ 6.7 m/ 6.8										
X2 0.78 B10 B10 (4)-42°ECF FURED 9/108 (400/770NAL 2-36" MESTALLED) X2 0.78 B10 B10 (4)-42°ECF FURED 9/108 (010 EXIST PIDE NO EXCESS (FROM PLINE STATION 42"ECF LITTE B5 3 PLINES X 150 NO EACE DITTE B5 3 PLINES X 150 NO EACE DITTE B5	144				500	200	18)-36 " P.D W/ F.G	017691	EILLET	EVACU
	•					ì	FROM PUMP STOTION	_	(400/Tinas) 7-26"	24500
X2 078 B10 B10 B10 (4)-48°ECP FORCED AND EXIST PIPE NO EXCESS (FROM PUMP STATION 42"ECP LINE B5 5 PUMPS X 150 NOV GFM) (NSTALLED)							3 PUMPS 150 000 CAM		11013H 38 1147 52010	
X2 0.78 BIO BIO (4)-40°ECP FORCED 9/105 1010 EXIST PIPE NO EXCESS (APONTIONAL 2- (FROM PUMP SSATION 42"ECP LALL BG 3 PUMPS X 150 000 GM) (NSTALL BO)							£4)			Z
X2 0.78 BIO BIO 64)-42ºECP FORCED 9/105 1012 EXIST PIDE NO EXCESS (FROM PUMP SSQION 42ºECP LALL BE 3 PUMPS X 150 000 GPP) 12574L50)	,									
X2 0.78 510 510 (4)-42° ECP FUREED 91405 1014 EXIST PIPE NO EXCESS (FROM PUMP STATION 42" ECP LINE 185 5 24775 X 150 000 GPM (1857 ALL 50)		• 1	-					_		
A F.G. (ADDITIONAL 2- PUMP SIGNOM 42"RCP WILL BG SX (SODO GM) (WSIALLED)	145	72		•	910		(4) - 42 ECP FURCED	Ш	101N EXIST	i
95 x 150 nor GPM 48" ECP LALL 95 x 150 nor GPM) 1455ALL 50)								Ш	2 JANOITICOAN	
03 X 150 000 GPM) 1N55AUE0	·•.						FROM FUMP STATION		١.	
*							3 PUMPS X 150 000 GPM			
		_								

TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

				TENTINENT IN COMMISSION ON SDE-DNAM	5	200-000	LEFF BAN	SKEENVIEW K	BN/NNHC/	CHHNNEL
11 0.17 241 262 42 26.0 24 294.0 204			SUBAR		TOTAL		SIDE-DRAINAGE REQUIREMENTS			
	a a	2		DISCHANGE PEAK C.F.S.	o Si	HEDIVIDUAL 0 CF.S.	DESCRIPTION	STATION	NEMANAS	
11 0.17 241 82 42 189490 PROFOSED ROP NO ETLESS 12 4 42 RCP 54 18440 COLLECTOR CAPE NO ETLESS 14 42 RCP 54 18445 CALLECTOR CAPE CALLECTOR				Ļ						
	140		<u> </u>		26	*	RCP	189.90		Excess
		7,					85	174.40	. `	
68			0:1	<u>~~</u>		٠				
368	147				é	X.	RCP 54			1
568 # 42" RCP 54 [14+55 579710N 1009750 67			_							
363 68				<u> </u>						
363	148			,	68	*	800	55+711		- 1
01 0.09 (122		···-		363<			68	107+80		7
01 0.09 (122		_							YOF FAIRVIEW	
01 0.09 (122	11/2				-				1	
01 0.09 122 48 100 +60 PUMPS WILL 55	*				61	*	RCP 54	166+45	47)	- 11
122 122 50" KCP 54 59.10 50.00 GP THE		7	_				89	100 +60		
55 * 30° RCP 54 159,80 4,475R 70 64NTA —— 48 97129 4NA RIVER. 4156 3 PUMPS 50.000 GPM EA. 50.000 GPM EA. 50.000 GPM EA. 50.000 GPM EA. 50.000 GPM EA.		<u>``</u>		\simeq						
4 30" RCP 54 159.80 4.475R TO GANTA —— 48 93.25 ANA RIVER. 4155 3 PLIMPS 50.000 GPN EA. 50.005 GPN EA. 50.005 GPN EA. 50.005 GPN EA.	•	_			1					
48 73125 4NA 115E 3 50.000 50.000	2				22	*		08 -651		- 0 -
" 0 0 °				,			899	43189	RIVER	
" 0 0 "					- = 					
0 0									USE 3 PUMPS	
8										
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TABLE 1 100-YR LOCAL STORM PEAK DISCHARGE

STEAMER SUBMER TOTAL SUB-CANAMIGE REQUIREMENTS REMARKS DIGINIOR STATION REMARKS DIGINIOR STATION	X	RTINE	N L	PERTINENT INFORMATION ON SIDE-DRAIN	8	SIDE-DRA	AGE INVESTIGATION	LOWER	SANTA ANA RIVER	
### \$12E POSCUMENT O HOW TOURN O STATION O S			SUBAR		TOTAL		SIDE-DRAMAGE REQUIREMENTS			
414 237 2400 24m 2400 TRAP CHANNEL 1821/4 LONFLYANCE STRUCT. NO EXCESS 4. 616 105 5600 GREENVIEW BANNING BS100 GREENVIEW BANNING NO EXCESS F 54. 613 54. 613 54. 613 54. 613 55. 610 610 611 612 613 613 614 615 615 615 615 616 617 618 618 618 618 618 618	N D	NAME			O CFS	INDIVIDUAL Q CFS.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
414 237 240 240 TRAP CHANNEL 19749 CONFLUANCE STRUE. NO EXCESS STRUE. SEAMING CHANNEL. 616 105 500 GREENVIEW BANNING BS100 GREENVIEW BANNING CHANNEL. 7 4 4 4 4 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1	į			_		┸) ł			
SANNING CHANNEL. SANNING CHANNEL. SANNING CHANNEL. STRUCTURE.	19/	274	_		228			152+90	LONFLYANCE STRUCT.	NO EXCESS FLOW
GV5 10.5 500 500 GREENVIEW BANNING BS100 GREENVIEW RAWING NO EXCESS FLO CHANNEL AND GVE AT STRUCTURE. 4 4 49 MILTON AVE 5 7 7 500 500 500 500 500 500 500 500 50									WITH GREENWEN	
GV6 10.5 500 GREENVIEW BANNING BS100 GREENVIEW BANNING NO EXCESS FLO CHANNEL INTO SANTA GV4 + ANA RIVER AT STRUCTURE + GV3 + GV3									BANNING CHANNEL.	
GVS 10.5 500 500 GREENVIEW BANNING BS100 GREENVIEW BANNING NO EXCESS FLO CHANNEL INTO SANTA GN4 HAMILTON AVE T GV5 GV6 GV6 GV6 GV6 GV6 GV6 GV6										
GVE 10.5 500 GREENVIEW BANNING BS100 GREENVIEW BANNING NO EXCESS FLO CHANNEL OWELLAND SANTA GVA HAMILTON AVE T GVE										
GVE 10.5 500 500 GREENVIEW BANNING BS100 GREENVIEW RAWING NO EXCESS - + GVA - GVA - + HAMILTON AVE - + GVE - GVE -										
GV6 10.5 500 500 GREENVIEW BANNING BS100 GREENVIEW BANNING NO EXCESS -+ GVA										
GVS 10.5 5000 GREENVIEW BANNING BS100 GREENVIEW BANNING WO EXCESS + + GVA + ANA RIVER AT GV3 + CHANNEL INTO SANTA CHANNEL CONFLUENCE + ANA RIVER GV3 - T GV7 GV7 GV7 GV8 - T GV8 GV8 GV8 GV8 GV8 GV8 GV8 GV		•								
CHANNEL INTO SANTA CHANNEL PONFLUANCE ANA RIVER AT HAMILTON AVE	152	615			2000	_	GREENVIEW BANNING		GREENVIEW BANNING	Excess
HAMILTON AVE		+ 1					CHANNEL INTO SANTA		CHANNEL CONFLUANCE	
HAMILTON AVE		614					ANA RIVER AT		STRUCTURE.	
		+					HAMILTON AVE			
		673								
		1								
		1								
		2								
					_					
						•				

SPF LOCAL STORM PEAK DISCHARGE

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

C. S. C. S.			SI PAREA				RIGHT BANK			
140 140 150 1601 1000 6 K 161, BOX WO GREESS 140 140 150 1601 1001 1000 1000 1000 1000 140 150 160 160 1601 1000 1000 1000 1000 1000 150 150 160 1601 1000 1600 100	S de	MARK	31.28	SOURCE		Windows	300	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
140 140 150 12° RCP 128.04 1010 EXIST PIPE 105.01 150.00 150.00 12° RCP 1189.94 1010 EXIST PIPE 105.01 180.00					1200	/250	CHANNEL	1206190	Ex/67.	GREESS
140 240 240 660" RCF 1102104 JOIN EXIST FIPE 1441 FLOCIDIA 19 100 1140 160 150 12" RCP 1102104 JOIN EXIST FIPE 1041 FLOCIDIA 18 1140 160 150 12" RCP 161187 1189180 JOIN EXIST FIPE NO EXCESS 25 400 30" RCP 335 RCP	`						'×B' RCB			
140 640 240 666" RCF 120104 JOIN EXIST FIPE 10401 FLOCIDIA 180 180 150 72" RCP 189192 JOIN 6XIST FIPE NO EXCESS 160 130 72" RCP (EIIST) 189182 JOIN 6XIST FIPE NO EXCESS 25 ADO 30" RCP 33" RCP 33" RCP 33" RCP										
14 0.84 2140 150 150 12" RCP [E115] 1189-94 JOHN EXIST PIPE NO EXCESS 150 130 12" RCP [E115] 1189-94 JOHN EXIST PIPE NO EXCESS 25 400 30" RCP 354 RCP 355 RCP 355 RCP	2				640	240	66" RCP	1202104	ı	LOCAL FLOODING
140 160 150 12" RCP 189492 JOHN EXIST. FIPE NO EXCESS 150 150 12" RCP 151157 189482 JOHN EXIST FIPE NO EXCESS 150 150 12" RCP 151157 189482 JOHN EXIST FIPE NO EXCESS 150										45 MOICATED ON
150 12" RCP 189,9 John Grist. Pipe NO Excess 150 12" RCP [51157] 189,10 John Grist Pipe NO Excess 150 13e 72" RCP [51157] 189,10 John Grist Pipe NO Excess 150 13e 72" RCP [51157] 189,10 John Grist Pipe NO Excess		, ,	,	,						PLATE.NE
150 12" RCP 189492 JOIN 6x15T. FIPE NO EXLESS 150 13c 72" RCP Exist 189482 JOIN 6x15T PIPE NO Exects 150 13c 12" RCP Exist 189482 JOIN 6x15T PIPE NO Exects 150 13c 12" RCP Exist 189482 JOIN 6x15T PIPE NO Exects		₹	2.0	04/7						REGIONAL PARK
150 13c 72 * RCP (EXIST) 1891.10 JOIN EXIST PIPE NO EXCESS 25 400 30 * RCP 35 * RCP	w,				150	150	12" RCP	1189.90	GX/ST.	Ex 2 655
150 13c 12° RCP (ENIST) 1189,160 JOIN ENIST PIPE NO 25 RCP 335 RCP										
150 13c 72 * RCP (EXIST) 18948 JOIN EXIST PAPE NO 25 400 50 * RCP 35 * RCP										
150 130 72. RCP (EXIST) 1189,160 JOIN EXIST PIPE NO 25 ADD 30" RCP 33" RCP										
25 ADD 30" RCP 32" RCP	A				150	130	$\overline{}$	1189.80	EXIST	1
Apo 30" RCP 30" R							$\overline{}$		1	
						52	30.		18	
	مرجور									

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

ORALE NAME					RIGHT BANK	2		
	SUBAREA	TEA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
10	E SIZE	DISCHANGE PE AK C.F. S.	o CFS	INDIVIDUAL 0 CFS.	DESCRIPTION	STATION	PEMARKS	DISPOSITION OF EXCESS FLOW
			00/	91	* 48" CMP	186+90	Jaw Exist moe	
i			00/	88	* 48" CMP	1194.95	JOIN EXIST PIPE	
~			00/	80	48° CMP	1184-20	JOIN EXIST PIPE	-
80			00/	50	4 48" CMP	1184,00	JOIN EKIST PIPE	45 MOJCATED ON
9. ""."	1.41	7370	/20	75	4 48°CHP	1185125	JOIN EXIST PIPE	PLOTE NE REGIONAL PARK
Q			120	75	* 48".04P	1183100	JOIN EXIST PIPE	
			00/	4	* 48" CMP	01 1/8/1	JOIN EXIST PIPE	
22			100	20	* 48° cnP	1181190	JOIN EXIST PIPE	
<u>w</u>			6550	3000	19'x 8.5' RCB	1180+16	JOIN EXIST BOX	LOCAL FLOODING
					101			PLAFE NE REGIONAL PARK

i.;

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

STATION REMARKS STATION (201-12 Join Exist. Pox No excess respectively) (201-12 ADD 3'x8'RCB & NO excess respectively) STRUCTURE FOR E 8'x8'RCB & 24"RCP 14" RCB 14" RCP 15" RCP 15" R	3			LEFT BANK	LEFT BANK			
CES 0	3	REA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
	×		C SE		DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
500			1660	100	X4.5'RCB	1211+10	1 1 1	1 1 1
500								
500 6' x 8' RCB (EXIST) 202+20 400 8' x 8' RCB 6 mo excess 900 8' x 8' RCB (MONOS) PROVIDE OUTLET 14 6 6 6 6 6 6 6 6 6								
400 B'XB' ROB (PROPOSE) PROMINE OUTLET U/F.G FOR LOWER AREA B'XB' RCB & 24"RCP STRUCTURE FOR E U/F.G FOR LOWER AREA 14" RCP PROVIDE OPN'G FOR U/F.G. FOR LOWER AREA 14" RCP 40 [4" CTIP (Exist)			1580	L	PCR.		Ann 2'48' D.C.B. 6	í
640 650 60" RCP (EXIST) 1184-56 (OIN EXIST, PIPE NO EXCESS 1/F.G. FOR LOWER AREA (OIN EXIST, PIPE NO EXCESS 1/F.G. FOR LOWER AREA 14" RCP 1/F.G. FOR LOWER AREA 15" RCP 1/F.G. FOR LOW				900	B'x 8' RCB (PROPOSE)		PROWIDE OUTLET	222
40 40 [4" CMP (EXIST) 184-56 1010 EXIST, PIPE NO EXCESS PROPOSED 24" REP PROVIDE OPN'G FOR	,	,			PROPOSED 14.RCP		FOR	
650 GO" RCP (EXIST) 1184-15 JOIN EXIST, PIPE NO EXCESS PROPOSED 24" RCP 19/F.G. FOR LOVER AREA 24" RCP 14" CTP (EXIST) 1171-90 REPLACE 24" CHP 10 [COLTRANS ORAIN] 10 KEPLACE WITH 36" CHP	á	2120			WEG FOR LOWER AREA			
650 (60" RCP (EXIST) 1184-15 JOIN EXIST, PIPE NO EXCESS PROPOSED 24" RCP 19.F.G. FOR LOVER AREA 24" RCP 40 24" CITP (EXIST) 1171-90 REPLACE 24" CHP (COLTRANS ORAIN) REPLACE WITH 36" CHP								
40 24° CTP (Exist) 117140 REPLACE 24"CHP NO EXCESS (COLTRONS DRAIN) WITH 36" CHP			640			1184.50	EXIST.	i 1
40 [4" CTIP (Ex18) 171490 REPLACE 24"CHP NO EXCESS (COLTRONS ORAIN) WITH 36" CHP					24.		OPN'G	
40 24° CTP (84157) 117140 REPLACE 24"CMP NO EXCESS (COLTRONS ORAIN) WITH 36" CMP					WF.G. FOR LOVER AREA			
40 24° Crip (84167) 117140 REPLACE 24"CMP NO EXCESS (COLTRONS DRAIN) WITH 36" CMP								
40 24° CMP (Exist) 117140 REPLACE 24"CMP NO EXCESS (COLTRONS ORAW) WITH 36" CMP REPLACE WITH 36"BP								
WTH 36"			40	40	_			1
					_		36"	
					REPLACE WITH 36'REP			

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

						BANK	••		
9		SURAREA	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
g g	NAME	SizE	DISCHARGE PEAK C.F.S.	C.F.S.	INDIVIDUAL 0 C.F.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
Ø				30	30	24" RCP	1166160	JOIN EXIST PIPE	NO GREGIS FLOW
6	,0,,	72.7	2180	1050	700	(2)-8'x 5' RCB FREE WAY BOXES	1163100	JOIN EXIST BOX UNDER FRWY.	LOCAL FLOODING 45 NOCATED ON PLATE
50				1200	og.	(2)-6'x 6' RCB FREEWAY BOXES	1157+90	Jain Exist BoxEs UNDER FRUY	
12				57	40	24" ReP	1154140	JOIN EXIST. PIPE	NO EYEESS FLOW
22				25	35	24" RCP	1150190	JOIN EXIST. PIPE	NO FILESS FLOW
10	é,	959	062/	25	87	24" RCP	1/45+90	JOIN EXIST. PIPE	NO EXLESS FLOW
#				06//	059	B'rG'RCB (EXIST) 48°RCP (PROP)	1134.70	JOIN EXIST BOX UNDE FRAY. PROVIDE 48"	LOGAL FLOODING US INDICATED ON PLOTE NE
52				25	91	24"RCP	1124140	JOIN EXIST. PIPE	

SPF LOCAL STORM PEAK DISCHARGES TABLE 2

ORASO CA			PERTINENT INFORMATION ON SIDE-	8		DRAINAGE INVESTIGATION - LOUER LEFT BANK	1056R	SANTA ANA	RIVER
A C		SUBAREA	IEA	TOTAL		SIDE-DRAMAGE REQUIREMENTS	-		
!	NAME	Size	DISCHANGE PEAK C.F.S.		MONYDUAL 0 CFS.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
1/2				/680	0.	(2)-0'xB' RCB	11/4+90	JOIN EXIST BOK	DEAL FLOODING
9								UNDER FR-WY	100104
	.25	61.0	1710						ON PLATE NE
17				3	38	24. RCP	105+90	JOIN EXIST. PIPE	NO BYCESS FLOX
			-						
							+		
							+		
							1		
*	1810	BLOCKED	1	GRAUTY	1.	CONDITIONS	1		

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

L.						,			FAGE GOF 34
	FRIE	FINE TO	FORMATI	3	SIDE-DR	PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION -	LOWER	SANTA ANA	RIVER
						RIGHT BANK	岩		
-	_	SUBAREA	REA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
2 2	D. NAME	NE SIZE	DISCHARGE PEAK C.F.S.		INDIVIDUAL Q C.F.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
28	•			80*	0	40" CMP	174 +95	JOIN EXIST PIPE	LOCAL FLOODING
									AS INDICATED ON
	_								ĺ
									IN REGIONAL PARK
-							+		
99	9 60	100	285	*					
<u>. </u>	_			9	0	12° CMP	1169100	JOIN EXIST. PIPE	
_							+		
							+		L LOCAL FLOODING
				1					45 INDICATED ON
_				lk (PLATE NE
00	_			20	0	72,600	06489/1	JOIN EXIST, PIPE	IN REGIONAL PARK)
_			· · ·				-		
									
_	_								
_	_								
794									
	$\frac{1}{2}$	4							
* '67									
* 7'		4 //				; 1			
	- 6	מרסרענה	GRAVITY		conor	COUDITIONS			

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

								2	T	_										П	
RIVER			DISPOSITION OF EXCESS FLOW		DNIGOOT TOODING	AS INDICATED ON	PLATE NE	IN REGIONAL PARK)	LOCAL FLOODING	AS INDICATED ON	ł	(IN REGIONAL PARK)									
					PIPE				3016												
SANTA ANA			REMARKS		JOIN EXIST				EX157.	ı											
					ı				10/2												
LOWER	X		STATION		1148195				26.87/				_								
DRAINAGE INVESTIGATION -	RIGHT BANK	SIDE-DRAINAGE REQUIREMENTS	DESCRIPTION		24" RCP				102" RCP												
SIDE-DRAI			INDIVIDUAL Q CF.S.		22				9.0												
8		TOTAL	O. C.F.S.		8				1200					 			 				
PERTINENT INFORMATION ON		EA	DISCHANGE PEAK C.F.S.					7076/			,										
		SUBAREA	SIZE				0 66							 -				 			
RTINE			NAME	_			,4	J						-	 	_	 	 	_		
PE			RA		3				32												

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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

			TENTINENT INTONINATION	5	אוטב - טאל	- DRAINAGE INVESTIGATION - Z	LOWER	SANIA ANH	KIVEK
		SUBAREA	ΙĒΑ	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
\$ \$	NAME	SIZE	DISCHARGE PEAK C.F.S.		INDIVIDUAL Q CF.S.	0E5CRIPTI ON	STA":1011	REMARKS	DISPOSITION OF EXCESS FLUW
20				90	300	du3"99	1/46+50	JOIN EXIST. PIPE	NO EXCESS FLOW
34				00/	230	12°CMP	1141400	JOIN EXIST. PIPE	No EXCESS FLOW
35				90	90	39" RCP	11/3+90	JOIN EXIST. PIPE	NO EXEESS FLOW
8	<i>E</i> .	0.35	970	%	0	GG" CMP	1124.9]	JOIN EXIST. PIPE	LOCAL FLOODING
16				%	780	C6 " CMP	11/4+20	JOIN EXIST, PIPE	VIOTE NE IN REGIONAL PACK) NO EXCESS FLOW
38				150	200	54* RCP	216601	JOIN EXIST, PIPE	NO EXCESS FLOW
39				360	750	(8) - 72"CMP	1095130	JOIN EXIST. PIPES	NO EXCESS FLOW
*	BLOCKBO	K & L	1	GRAVITY	1.	CONDITION			

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

Ī						RIGHT BANK			
		SUBAREA	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
A DE	NAME	3212	DISCHANGE PEAK C.F.S.		INDIVIDUAL 0 CF.S.	<u> </u>	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
				959		World of 1910	2772	1011 Fort DIDE	AN ENGER ES
\$					250	60" RCP 10KOP)	20,00	11 000	2
						2		60" RCP	
	*			9	12	250	1		
	r	0.0	8	2	000	# 45. KCF	130+30	JOIN EXIST. PIPE	NU EKEGSS FLAN
4				940	0001	60'4 84" 809	11/2-10	Join Frist Plats	NO GYGES BLOOM
)	-							1 (1 1
	. — ·								
			,						
-									
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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

			000			3				Γ					
		DISPOSITION OF EXCESS FLOW	NO EXCESS FOUR			NO EXCESS RUD									
		REMARKS	JOIN EXIET PIPE			 JOIN EX	WSTALL GODITIONAL	1							
X		STATION	1076+4			1000	0/24/0								
RIGHT BANK	SIDE-DRAMAGE REQUIREMENTS	DESCRIPTION	36" RCP	AP GATE			34 KCF (CA)(0/5+10								
		INDIVIOUAL Q C.F.S.	8			26	45								
	TOTAL	Q CFS	B			 /80	3	-							
		DISCHARGE PEAK C.F.S.			760			-							
	SUBAREA	SI ZE			0,10										
		NAME			1,1						 	 			
	7179	ğ	 43			 44	•		 		 	 	 	 	

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

4	¥ 11	SUBAREA SUBARE	DISCHANCE FEAN C.F.S. 3440	TOTAL O CFS 3460	0 Cf. 8.	SIDE-DRAMAGE REQUIREMENTS DETCRIPTION (3) - 12'x7' RC.B.	S STATION	MEMARYS JOIN EXIST BOX UNDER FRUY	DOPOSITION OF EXCESS FLOW COCAL FLOODINGS DAY
4 4	in we	0.57	2970	2790		(3) -8"x (EX!)		JOIN EXIST. BOX JOIN EXIST PIPE	IN KEGIOUME TAKKI LOCAL FLOODING SOUTH OF RIVERSA THE PROJECT AREA NO EXCESS FLOOD
49	i		,	120	96	1, 56" RLF (PROF) 48" RCF	061-30		LOCAL FLODOING 45 INDICATED ON PLATE NE

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

W	RTINE	N F	PERTINENT INFORMATION ON SIDE-	8	SIDE-DRA	DRAINAGE INVESTIGATION - LOWER	Louin	SANTA ANA	RIVER
	ļ					RIGHT BANK			
3		SUBAREA		TOTAL		SIDE-DRAMAGE REQUIREMENTS			
đ	NAME	S1 2E	DISCHANGE PEAK C.F.S.	O CFS	INDIVIDUAL 0 CF.S.	MO114192330	STATION	REMARKS	DISPOSITION OF EXCESS FLUX
4	*14	2.35	8110	970			1000		
:	•	· ·	040	2	2000		1066130	ヘ Ⅰ	No EXCESS FLOW
				_	240	1		INSTALL ADDITIONAL	
								60" RCP.	
8	"/"		000						
		7/17	0946	2460	4000	10'x 11.5' RCB	1059.90	JOIN EIJST. BOX	NO EXCESS FLOW

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

										PAGE 13 OF 39
10 10 10 10 10 10 10 10	2	E E		OPNATIO	3		INVESTIGATION -	OUER	SANTA ANA	RIVER
1										
12 05 04 05 05 05 05 05 05			SUBA	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
"[" asi 350 100 54" RCP (Exiet) 1046-76 610 Exiet 100000000000000000000000000000000000	g	PARE	32 18	DISCHANGE PEAK C.F.S.	o CFS	₹ .	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLOW
12 0.61 350 120 60" RCP (PROP) 140PRUL ADDITIONAL AS INDICATED 100 61 62 62 62 62 62 62 62 62 62 62 62 62 62	ù				/40	90	EA " OA B / E.			, ,
12 a61 1350 240 140 54" RCP (ENS) 1051-10 (AN ETIET PIPE 100 250 54" RCP (ENS) 1051-10 (AN ETIET PIPE 100 250 550 65" RCP (ENS) 1051-10 (AN ETIET PIPE 100 250 550 65" RCP (ENS) 1051-10 (AN ETIET PIPE 100 250 550 65" RCP (ENS) 1051-10 (AN ETIET PIPE 100 250 550 550 65" RCP (ENS) 1051-10 (AN ETIET PIPE 100 250 550 550 (BN ETIET PIPE) 1051-10 (AN ETIET PIPE) 1051-10 (BN ETIET PIPE) 1	<u> </u>				970	202/	т `	100010	101N EXIST. 54-16.	ŽI.
190 190 54" RCP (ENS) 1051-190 MISTORIAL ADMITIONAL NO EXCESS FILE 120 150 54" RCP (ENS) 1051-190 MISTORIAL ADMITIONAL NO EXCESS FILE 121 12				1220			~		GO" RCP	-
240 40 54" RCP ENST 1057-40 WSTALL ADDITIONAL NO EXCESS FE				<u>}</u>						
13 0.49 1060 250 50" RCP (EXIST) 102474 1011 514" RCP 10 EXLESS 13 0.49 1060 26 50" RCP (EXIST) 102145 REPLACE 12" 67" RCP 14 12 12 12 12 12 12 12 12 12 12 12 12 12	22				290	06/	54" RCP (EXK)			EXC. 855
13 0.49 1060 250 54" RCP (EXIST) 1029.12 101110 41 GG 14						001	42" RCP (PROP)			
15 0.49 1060 15 40 COS RCP (PROP) 102412 ADDITIONAL GG 10 ENLESS 15 40 (27 (PROP) 201145 REPLACE 12 STL NO EXCESS R 15 30 30" CMP (PROP) 20114 30" CMP 16 640 (4) - 48" RCP 100744 1011 EXIST PIPES LOGGE 12 PLATE NE	•				2.0	200		_		
13 0.49 1060 26 12" STILEXIST DILMS REPLACE 12" STL NO EXCENS 16 12" STILEXIST DILMS REPLACE 12" STL NO EXCENS 17 30 30" CMP (PROF) WITH 30" CMP 19 30" CMP (PROF) WITH 30" CMP 10 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 10 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 10 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 10 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 10 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 10 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 10 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 10 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 10 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 11 60 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 11 60 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOCAL FLOOR 12 60 70 70 70 70 70 70 70 70 70 70 70 70 70	ŭ_				3	35,	~	1024120	101N EX16T. 54" RCP	EXCESS
13 0.49 1060 26 40 12" 571 (EXIST) 1021-95 REPLACE 12" 671 NO EXCESS 10 1060 REPLACE 12" 671 NO EXCESS 10 1060 REPLACE 12" 671 NO EXCESS 10 1060 REPLACE 12" 671 NO EXCESS 10 1060 REPLACE 12" 671 NO EXCESS 10 1060 REPLACE 12" 671 NO EXCESS 10 1060 REPLACE 12" 671 NO EXCESS 10 1060 REPLACE 120 GOTES 46 NOICATED 10 1060 REPLACE 120 GOTES 46 NOICATED 10 1060 REPLACE 120 REPLACE 1						200	7		INSTALL ADOLTIONAL GE	
13 0.49 1060 16 40 12" 571(EXIST) 101145 REPLACE 12" 671 NO EXCENS 15 40 24 " RCP (PROP) M346 REPLACE 18" 611 NO EXCESS F 30 30" CHP (PROP) W174 30" CHP 40 640 (4) - 48" RCP 100144 JOIN EXIST PIPES LOCAL FLOOR NO EXCESS F 100144 JOIN EXIST PIPES 1004 FLOOR NO EXIST PLATE NO EXPENSE 100145 M857944 FLOOR NO EXIST PIPES LOCATED PLATE NO EXCESS F 100145 M857944 FLOOR NO EXIST PIPES NO EXPENSE 100146 AND EXIST PIPES NO EXPENSE NO EXPENSE PIPES NO EXPENSE NO EXPENSE 100146 AND EXIST PIPES NO EXPENSE P		•							Rep	
15 30 20 CMP (EXIS) 1013460 REPLACE 18"AMP NO EXCESS POPOLA (4) - 48" RCP 1007440 1014 EXIST PIPES LOGGE FLOOR INSTACL FLOOR PLATE NE	4		0.49		25		T	2001201	·I	1
16 30 30" CMP (ELIS) 1013460 REPLACE 18" AMP NO EXE 460 640 (4) - 48" RCP 100744 JOIN EXIST PIPES LOGGE 100744 JOIN EXIST PIPES LOGGE 100744 JOIN EXIST PIPES LOGGE 100744 JOIN EXIST PIPES LOGGE 100744 JOIN EXIST PIPES LOGGE 100745 JOIN EXIST PIPES LOGGE 100745 JOIN EXIST PIPES LOGGE 100747 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 10077 JOIN EXIST PIPES LOGGE 1007	-					40	(PROP)		24"	1
460 640 (d) - 48" RCP (007440 101N EXIST PIPES LOGGE					10					
960 640 (4) - 48" RCP 1007+40 101N EXIST PIPES LOGGE 1NOTO	٥	***			22		18" CMP (EXIST)	10/3/60	REPLACE 18" AMP	1
960 640 (d) - 48" RCP 1007+40 1014 EXIST PIPES LOGGL 1016						30	30" CMP (PROF)		30,0	: :
INSTALL FLOP GATES 48 /NOICE	<u>.</u>				960	640	- 48" OCP	1007140	67.164	- 1
PLATE NE	_							21/2/		As worders
										PLATE NE
	7	7								ı

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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

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SUBAREA NO NAME SIZE PEAK 57 "14" 0.44 1000	TOTAL ZES		BANK			
MANE SIZE			SIDE-DRANAGE REQUIREMENTS			
17, 0.44	3%	INDIVIDUAL Q CF.S.	DESCRIPTION	STATION	PEMARKS	DISPOSITION OF EXCESS FLOW
1,4" 0.44	35	₽				200
17, 0.44		740	RCP	99410	11/2	NO EXCESS FLOW
17, 0.44			36" RCP (EXIST)		RCP & SG" RCP WITH	
17, 0.44			12 " RCP (PROP)		72" RCP. PROVIDE	
17, 0.44			-		OUTLET STRUCTURE	
1/4 0.44						
	001	22	2-30" CMP (EXIST.)	990+90	JOIN EXIST PIPES	NO EXCESS FLOW
		L_	30"CMP (PROP)		INSTALL ADDITIONAL	
			t		30" CMP	
6.5	1/20	1/2	49, 60.0	984150	JOIN EXIST. PIPE	DNIGOOTH 10707
	<u>}</u>					AS INDICATED ON
						ITE NE
-						

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

L						1			LO LO SI SOLI
2	2	2	PENTINENT INFORMATION ON SIDE-	3		DRAINAGE INVESTIGATION - Ze	LOLIER	SANTE ANA	RIVER
						RIGHT BANK			
		SUBAREA	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
P. D.	MANÉ	Si 2E	DISCHANGE PE AK C.F. S.	O CFS	MDIVIDUAL 0 C.S.	MOLEGNETION	STATION	PEMARINS	DISPOSITION OF EXCESS FLOW
3				59	59	30 4 C P [EIS] (1	1046156	REPLACE 30"RCP	NO EXCESS ROW
E C				*	34	(3) - 36"CHP W. KG. 103/130	D\$1150	YOIN GXIST. PIPE	NO 51655 FLOW
79				*	3/4	FRON POND TO RIVER (4) - 36" CMP	1030140	JOIN EXIST. PIPE	NO EXCESS FLOW
	**	0.35	140			WORKS) RIVER			111
63				610	eio eio	TO SPREADING GRD	01440	JOIN GXIST. PIPE	NO EXLESS FLOW
64				115	311	TO SPREADING GRD)	50+6101	JOIN EXIST. PIPE	NO EXEESS FLOW
65				*	*	4 -36°CHP W GATES (DIERSION WORKS)	93.676	JOIN EXIST. PIPE	NO EXCESS FLAN
**	0	o.c. v. p.		DIVERSI GROUND BASINS (,	13 /1	ON WORKS FOR WATER RECHARGE	2		

161 to 12 14 161

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION - LOLLER LANK SUBAREA TOTAL SIDE-DRAINAGE REQUIREMENTS OSCIPLINE STATION OCCUPANCE MENTS OSCIPLINE STATION STATION OCCUPANCE MENTS STATION OCCUPANCE MENTS STATION OCCUPANCE MENTS STATION OCCUPANCE MENTS STATION OCCUPANCE MENTS STATION OCCUPANCE MENTS STATION OCCUPANCE OF STATION STATION OCCUPANCE OF STATION STATION OCCUPANCE OF STATION OCC
0,63 (490
SUBARE SIZE

797 AN 25 177 7.18

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

			Ft.0#	3073	Fron	Ko		080	П				
3			OF EXCESS FLOW	EXLESS FLOWS				1911					
				1668	EXCESS	Excess		COL	7				
PINER IN CIT			DISPOSITION	NO E.	No i	NO C		100AL F100 46 WOICATED	PLAIC				
à		L	<u> </u>		111				44		1		
ANA				1	WORFASE TO AS	ADDITIONAL		JOIN EXIST PIPE					
			Ş	3316	2 20	20171		PIPE					
17.			HEMARKS	167	180	1 1 21 1	0	X157	808				
5 A.V.T.A				JOIN EXIST	1000	Jan E.	48"800	JOIN EXIST	24.				
1					1 19		40	1 1 7					
LOWER			STATION	955+10	591866	938165		54" RCP (EVST) 978+56					
	ZAK	ITS			19		++	250	++	H	+		
INVESTIGATION -	LEFT BANK	PEMEN	_			EXIST)		(PROP)					
STIG	37	REQU	DESCRIPTION	24. CMP	42° cnP	1 1/1/1		RCP RCP					
N		MANAG	DESC	54.	42.	42" RCP (24					
DRAINAGE		SIDE-DRANAGE REQUIREMENTS				4.0		2-54"					
			NOIVIDUAL Q CF.S.	2	(95)	33	11	090	$\dagger \dagger$		\top		
QUS N		\ V					11			Ш			
8		TOTAL		30	138	240		150					
PERTINENT INFORMATION ON SIDE-		¥3	DISCHANCE PEAK C.F.S.			97/							
IN INF		SUBAREA	Size			0,50							
TINEN			MAN			.9	- 						
PER			đ	2	72	25	,	4				\dashv	

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

FERTINENT INFORMATION ON SDE-DRAINAGE INVESTIGATION - LOUGE C SALLTA AND RIVER. SIGNATE AND SIZE TOTAL SECUNDANCE REQUIREMENTS REMAINS DISPOSITION OF EACH STORM	WALL HAR	SUBA	PORMATIO				,		
SUBANTEA 10741 SOC UNAMAGE RECUMENTS NAME 512		SUBA		5	SIDE-DRA		LOUER	SANTA ANA	KIVER
SUBMER TOTAL SIDE_URANANGE REQUIREMENTS REMAINS DISCUSSION OF EXCESS		SUBAR				RIGHT BANK	וע		
CFS CFS			IEA	TOTAL		SIDE-URAINAGE REQUIREMENTS			
			DISCHANGE PE AK C.F.S.	O CFS	4	DESCRIPTION		PEMASHS	DISPOSITION OF EXCESS FLOW
MIL BIR (NO NO K 44) - 26" KCF WELLS INN EXIST. FIPES NO CREESS DIVERSION WORKS GROUND GROUND GROUND GROUND GROUND				R					
				B	¥		211916		Excess
	······································					w/ GATES		SHUERSION WORKS	
						(diversion works		TO THE SPREADING	
								GROUND	
	 								
		·=							
		_							
	# INTOKE		DRAINS	FOR	OCNO	OCND GROUND WATER	RECHARGE	RGE BASIN (NO LOCAL	AL STORM DRAIN

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

SANTA ANA RIVER			REMARKS DISPOSITION OF EXCESS FLOW	JOIN EXIST. PIPE NO EXCESS FLOW		JOIN EXIST. PIPE NO EXCESS FLOW		JOIN EXIST 18" RCP & NO GREESS FLOW	WSTALL 400/TIONAL	18"RCP.		ION EXIST 2-48" RCP NO EXCESS FLOWS	VSIALL ADDITIONAL	18"RCP W/ F.G.		101N EXIST 48" 48" NO EXCESS FLOW	•	1/4.6.		JOIN EXIST GOT RCP NO EXCESS FLOWS.	APDITIONAL	ŀ	0. Kc/.
MUGEN				1 1	1 1	1 3 1										NO EXCE.				1			
SANTA ANA			PEMARKS	JOIN EXIST.		1		JOIN EXIST	INSTALL ADDITIONAL	18" RCP.		1014 Ex158 2-48" KCP	MASTALL ADDITIONAL	48.8CP W/ F.G.		27 8, 87 151X3 NIOF	INSTALL ADDITIONA 48 REP.	W/ F.G.		JOIN EXIST GOT RCP	INSTALL ADDITIONAL		
LouëR			STATION	926+45		67.426		lerks) 923 tos			201485			Ī	898+00				_				
DRAINAGE INVESTIGATION - Z	LEFT BANK	SIDE-DRAMAGE REQUIREMENTS	DESCRIPTION	GO" CHP		36° RCP		وا	18" RCP (DEDD)	•	(2) - 48" RCP	12/ F. G. (Ex157)	48 + RCP 10 / 16 / PROP)	1 /	48. RCPE 47. RCP 898+0		48.4CP 166/PROP		60 * RCP (ENNS) B71+10	(008d) dod .09			**************************************
			INDIVIDUAL 0 CF.S.	500		10		6/	Ø)		250		125		180		9		240	240			
NO N		TOTAL	OF.S	340		6	,	22		777	242			•	7			_	470				
PERTINENT INFORMATION ON SIDE-		EA	DISCHANGE PEAK C.F.S.								0001							<u> </u>		, —			
NT IN		SUBAREA	S: 2E								0.30												_
RTINE			NAME						,,		7/7												
15			đ	12		11	,	9		;	2			(80			19	ò				

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

ION EXIST DRAINS TO RECHARGE BASIN TO RECHARGE BASIN	=		Ž	PERTINENT INFORMATION ON SIDE	3 3 2	SDE-DK	-DHAINAGE INVESTIGATION - LOUINE	ここと	SALTA ANA	がシかみ	
SIZE DECLARATE STATION STATION RELIABLES SIZE OF STATION CESCRIPTION STATION RELIABLES SIZE OF STATION CONTROL OF STATION STATION OF STATION							RIGHT BANK				
S12E PERM OF GENTRON STATION REMARKS DESCRIPTION OF EXCESS TO SECURD OF STATION STATION OF EXCESS # (4) 24°C/NP U/847E) 893+74 /UN/ Exist. DRAIMS NO Excess # (4) 36° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (4) 36° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (4) 36° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (4) 36° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (4) 36° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (5) 200 RAIM NO STATES # (4) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (5) 200 RAIM NO STATES # (5) 200 RAIMS NO Excess # (5) 200 RAIMS NO Excess # (5) 200 RAIMS NO Excess # (5) 200 RAIMS NO Excess # (5) 200 RAIMS NO Excess # (5) 200 RAIMS NO Excess # (6) 200 RAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (6) 200 RAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (6) 200 RAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (6) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (7) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° RCP 8521/5 /UN/ Exist. DRAIMS NO Excess # (8) 26° R	1 1	ā	UBAR	EA	TOTAL		SIDE- JRAINAGE REQUINEMENTS				
# (4) 24°CMP W/BATES BASTA TO BECHARGE BASIN DIVERSION WORKS # (4) 36° RCP BS2115 TON EXIST DRAINS NO EXCESS (DIVERSION WORKS) DRAIN TO STREADING RELEASE FLOW DIVERSION DIVERSION			32 15	DISCHANGE PEAK C.F.S.	C.S.	INDIVIDUAL Q CFS.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXC	ESS FLUB
# (4) I4°CHP U/BATES BASIN NO EXCESS DIVERSION WORKS TO RECHARGE BASIN (4) 36° RCP 852115 JOIN EXIST DRAINS NO EXCESS (OVERSION WORKS) ARAIN TO SFREADME ARELEADE ARECHARGE BASIN DIVERSION ANTO CARROW CAN DIVERSION											
# (4) 36" RCP 952115 TO RECHARGE BASIN OWERSTON WORKS TO RECHARGE BASIN DECHARGE BASIN TO RECHARGE BASIN TO RECHARGE BASIN DECHARGE BASIN TO RECHARGE BASIN TO RECHARGE BASIN DECHARGE BASIN TO RECHARGE BASIN TO RECHARGE BASIN DECHARGE BASIN TO RECHAR	~	<u>, a</u>				*	1	893+90		,	1
(4) 36° RCP BS2+15 IOIN EXIST DRAINS NO EXCESS (DIVERSION DOROS) AR DIVERSION NTO CAR PON CAN DIVERSION							! \ .		1		1
(4) 36° RCP 952115 JOIN EXIST DRAINS NO EXCESS (DIVERSION WORKS) TO RECHARGE BASIN DRAIN TO SPREADING RELEASE FLOW NOTO CAR ROW CAN DIVERSION											
(4) 36° RCP 852115 TON EXIST DRAINS NO EXESSS OVERSION WORKS DRAIN TO SPREADING AROUND PONDS RELEASE FLOW NITO CAR ROW CAN DIVERSION											
(4) 36° RCP 852115 Join Exist DRains NO Excess (DIVERSION WORKS) DRAIN TO SPREADING RELEASE FLOW NOTO CARROW CAN DIVERSION											
TO RECHARGE SASIN DRAIN TO SPREADING GROUND PONDS RELEASE FLOW INTO CAR MAN CAN DIVERSION						*	36,	852115	EXIST	l	1
SFREADMA PONOS FLOW POW CAN			-				(DIVERSION WORKS)				1
		_						,			
							_				
		\dashv	7								
RFLOW DRI	*	100 100 100 100	12 K	934	TOR O	900	FOR POR				
NO LOCAL STORM FLOW)	٠					1					

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

						KACH! BANK			
	Ц	SUBAREA	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS	·		
	NAME.	SI ZE	DISCHANGE PE AK C.F. S.	C.S.	INDIVIDUAL Q CF.S.	DESCRIPTION	STATION	REMARKS	DISPOSITION OF EXCESS FLUN
88	· W	3.80	0059	0055	5600	TRAP, CHANNEL		BAC-15 1014 CARBON CANYON CHANNOS CHANNEL CONFLUANCE STRUCTURE	NO EXSESS FLOW
	1								
8				*	*	36°CHP W/F.G. BASIN INCET	844.4	F.G. BALLET 101N EXIST. INLET DRAIN	NO EYCESS FLOW
8				**	*	(4)- 36°CMP W/GATE BASIN INCET	844+13	4)- 36°CHP WGATE 844+25 (OIN EXIST. INLET DRAINS BASIN INLET (NOT A STORM DRAIN)	NO GREESS FLOO
81				*	34	(2) - 36"CMP W/GATE	813+80	1014 EXIST NIET DRAINS ADD 51.05 GATE (NOT & 570EM DRAIN)	NO EXCESS FLOW
88	, doe	900	00/	180	0	42º RCP W/ F.G.	02+64	1 12 96	EXCESS FLOW WILL BE SEE
5						40 KLT W/ T.G.	0/4/0/	POND	1. 1

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

99 126 2760 GF S SUB-DRAWLAN ORANGE OF HONOWALL OF STEE OF SUB-DRAWLAN OF STEE OF SUB-DRAWLAN OF	PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION -	IGATION - LOWER	SANTO AND	RIVER
MAME SIZE PRAME Q INDIVIDUAL CFS CFS CFS CFS CFS CFS CFS CFS CFS CFS	SIDE-DRAMAGE REQUIREMENTS	MENTS		
"p" 1.61 2760	3	STATION	REMARKS	DISPOSITION OF EXCESS FLUW
"p" 1.61 2760 50 50 30 30 30 00 00 00 00 00 00 00 00 00 00	55 30° KCP	805+56	JOIN EXIST. PIPE	No ExeESS Flows
200 009 00 00 00 00 00 00 00 00 00 00 00	30 36" CHP	799-15	ON EXIST. PIPE	NO EXCESS FLOW
"a" 0,72 610 610 32.0 690 "op" op" op" op" op" op" op" op" op" op	150 42" RCP	197.40	JOIN EXIST. PIPE	NO EXEGSS FLOW
24 0,32 610 610 320 60 320 60 320 60 320 60 60 300 600 600 600 600 600 600 600	0 (2) 7'×7'	RCB 188105	IDIN EXIST BOX	LOSAL FLODOING 45 NOICATED ON PLATE NE
00 00 00 00 00 00 00 00 00 00 00 00 00	66" 80	RCP (EIX) [63+50 P (PROP)	TESTSO INSTAUL ADDITIONAL GE" RCF.	NO EXU
	174 (174)	CHP BSO12	JOIN EXIST. PIPE	NO EXCESS FLOW

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

Production of the second of th	SI ZE DI	PE AN PE AN C.F.S.	25. S. S.	1 3	SIDE-DRAMAGE REQUIREMENTS			
***				4				
20		9	8	12	DESCRIPTION	STATION	MEMARKS	DISPOSITION OF ENCESS FLOW
v.		o,	0	22	16° CMP (EXIST) 710+16	711011	REPLACE 16" CMP	NO EXCESS FLOW
v.		9	0				cne	1 1
v.		,	<u> </u>	4	6411 010	710011	SOID TAKE	Aut 6/00/01
v.		,0,	4			21101		AS INDICATED ON
v		101						PLATE NE
		6707	345	170	45° RCP	740+35	JOIN EXIST. PIPE	LOCAL FLOODING
	_							AS INDICATED ON
	_		,					+
			9	2	14º ACP	724180	10/N EXIST PIPE	NO GREESS FLOW
- 26 -	-				FORCE MAIN		(FORCE MAIN)	
					FROM PLINP STATION			
00			77/					į
			140		27" KCP/EIIST/710+00	110+00	REPLACE 27" RCP	NO CREESS FLOW
		, 		05/	48" RCP (PROP)		WIH 48" RCP.	
-								
				1				
	-							

THE PIL 25 189 THE

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

SIBARE A TOTAL SIDE-DRAMAGE RECUMENENTS WAME 51.2E PESS CFS CFS CFS PTION STATION REMAYS CFS CFS CFS PTION STATION REMAYS CFS CFS CFS PTION STATION REMAYS CFS CFS CFS PTION STATION REMAYS REMAY	SUBANEA TOTAL SIDE-DRAWLIGE REQUIREMENTS WHANE SIZE OF SIZE O	Subanke Total Side-Dramage Requirements NGAL Babbs Station NGCHARGE Side	*	NE NE		PERTINENT INFORMATION ON	3	SIDE-DRA	DRAINAGE INVESTIGATION - LOUER	LOWER	SALITA ANA	RIVER
SUBANTEA TOTAL SDC-DRAWLGE REQUIREMENTS REQUIREMENTS NAME 51.72	SUBMERA STEE OF CHANGE RECUIREMENTS WAME SIZE OF CAS GS GS GS GS GS GS GS GS GS GS GS GS GS	SIGNATE A STEE ORANNING RECUIREMENTS NAME SIZE OFFINA O MOVOULA OF 2.05 2.100 1200 1200 1200 1200 1200 1200 120							RIGHT DAN	L		
1.0. 2.05 2.200 1200 1200 1200 1200 1200 1200 120	1.0° 2.08 2200 2200 12'x 9.5' RC B 747.40 745 15 745 RC B 100000000000000000000000000000000000	1,0 1,0			SUBAR	EA	TOTAL		SIDE-DRAINAGE REQUIREMENTS			
"0" 2.08 2100 1200 1200 121 95" RCB 745-95 745-8 NO 75-0 15-0 10 10 10 10 10 10 10 10 10 10 10 10 10	WAKE PIPES FOR DEAD GROUND NOTER	WAKE PIPES FOR OCND GROUND STORY)		NAME	SIZE	DISCHANGE PEAK C.F.S.	CFS.	3	MOELCH IPTION	 -	REMARKS	DISPOSITION OF EXCESS FLOW
"0" 2.08 2100 1200 1200 12'X 4.5' RCB 147-40 7115 15 77-6 RCB NO 700 77-0 77-0 80-80-80-80-80-80-80-80-80-80-80-80-80-8	1.05 1100 1100 1200 12x4.5' RCB 147.40 1105 15 THE RCB NO 1.0 THE SPECIOUM 1.0 THE	1.05 1100 1100 1200 12x 9.5' RCB 147.4% 1415 15 The RCR NO 15cmared med No 15c										
Sex bisenarging To The Speedoins Ground Afrin.	WAKE PIPES FOR OCND GROUND NATER	WAKE PIPES FOR OCAL STORM DRAIN)	ool	0;		2200	1200	(8)			THE	- 1
GROUND BASIN.	WAKE PIPES FOR OCND GROUND LATER	WOKE PIPES FOR OCND GROWND NATER RECHARGE BASIN (NO LOCAL STORM DRAIN)									(1
GEOWND BASIN.	WAKE PIPES FOR OCND GROUND LOTER	WAKE PIPES FOR OCND GROUND LATER RECHORGE BASIN (NO LOCAL STORM DRAIN)									TO THE SPREADING	
	WYOKE PIPES FOR OCND GROUND LATER	WAKE PIPES FOR OCND GROUND LOTER RECHORGE BASIN (NO LOCAL STORM DRAIN)								_	SROUND BASIN.	
	WOKE PIPES FOR OCND GROUND NAT	WARE PIPES FOR OCND GROUND SAT										
	MOKE PIPES FOR OCND GROUND NAY	WARE PIPES FOR OCND GROUND SAY										
	MOKE PIPES FOR OCND GROUND NAY	WARE PIPES FOR OCND GROUND SAY										
	WOKE PIPES FOR OCND GROUND NAT	WOKE PIPES FOR OCND GROUND SAT								-		
	WOKE PIPES FOR OCND GROUND NAY	INTOKE PIPES FOR OCND GROUND NAT								-		
	WOKE PIPES FOR OCND GROUND NAY	WANKE PIPES FOR OCND GROUND NAT										
	MOKE PIPES FOR OCND GROUND NAY	WAKE PIPES FOR OCND GROUND SATECHORGE 1305111 (NO LOCAL STORM										
	MOKE PIPES FOR OCND GROUND NA)	WARE PIPES FOR OCND GROUND SAY										
	INTOKE PIPES FOR OCND GROUND SAY	MOKE PIPES FOR OCND GROUND SATE RECHORGE 1305111 (NO LOCAL STORM										
	WOKE PIPES FOR OCND GROUND NAN	WINKE PIPES FOR OCND GROUND SATECHORGE BASIN (NO LOCAL STORM										
	WOKE PIPES FOR OCND GROUND NAY	WIDKE PIPES FOR OCND GROUND SAY										
	MOKE PIPES FOR OCND GROUND NAY	WAKE PIPES FOR OCND GROUND SAT										
	INTOKE PIPES FOR OCND GROUND NAY	WARE PIPES FOR OCND GROUND SAS										
	WIDKE PIPES FOR OCND GROUND NAY	WINKE PIPES FOR OCND GROUND SAST									التالة ومدناه المساورة والمساورة والمساورة والمساورة والمتالة والمتالة والمساورة والمتالة والمساورة	
	WIOKE PIPES FOR OCND GROUND SAS	NIOKE PIPES FOR OCND GROUND SAS RECHORGE BASIN (NO LOCAL STORM										
	WOKE PIPES FOR OCND GROUND LAN	NIAKE PIPES FOR OCND GROUND DAY RECHARGE BASIN (NO LOCAL STORM										
	INTOKE PIPES FOR OCND GROUND DAY	INTAKE PIPES FOR OCND GROUND WAS										

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

		T		П	٦	T	S	Q	T		Γ	Γ	Τ	Γ	Γ	Γ	Γ	Τ	Γ	Γ		Г	
RIVER			DISPOSITION OF EXCESS FLOW		COLLINS CHANNEL	DESIGN CAPACITY	15 3200 CFS. FICE	WILL FL	AT THE INCETE TO														
					xoc	164665	168,0																
AND AINHS			REMARKS	7	W CXID	BACK	TO FLEW. I																
1000V			STATION	0.00	671+20				1														
CHAMPOL INTEGLICATION	LEFT BANK	SIDE-DRAMAGE REQUIREMENTS	DESCRIPTION		WY 21 X 21 /2	COLLINS CHANNEL																	
200		S	HEDIVIDUAL Q C.F.S.	7,000	1000																		
5		TOTAL	O CFS	(00)	2000																		
TENTENT IN CHARTICAL ON			DISCHARGE PE AK C.F. S.		0220 0239																		
		SUBAREA	31 ZE	100	4:40																		
			HAME		¥																		
١			A D		j j																		

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

SECRIPTION STATION NEWARTS DISCUSSION OF EXCESS OF A CAPPER PROPERTY OF STATION OF STATES AND STATES OF ST	2			CHAMPIN	5	30c-043	PERTINENT INFORMATION ON SIDE-URAINAGE INVESTIGATION - LE	LOUER	SANTA ANA	RIVER
102 111 0115 570 110 015 017 017 017 017 017 017 017 017 017 017			7	EA	TOTAL		SIDE-DRAWAGE REQUIREMENTS			
105 111 0.15 570 (10 87.12) RCB 175110 (10 81.57 80.8 10 81.655. 105 111 0.15 570 (10 87.12) RCB 18.10 (10 81.57 80.8 10 81.655. 104 (20 36.80.7) 688140 2551.00 81.10 81.655. 105 111 0.15 570 (10 36.80.7) 688140 2551.00 81.10 81.655. 105 111 0.15 570 (10 20.80.7) 688140 2551.00 81.10	4			DISCHAREE FEAK C.F.S.	O. S. S.			STATION	REMARKS	DISPOSITION OF EXCESS FLOW
103 III alf 570 IIO 36" CMP[EXEN] 6881/4 REPLACE 36" CMP IND EXLEGES INT ABOVE TO BE AND MATH 48" ECP TO BE AND MATH 48" ECP TO BE AND MATH 48" ECP TO BE AND MATH 48" ECP TO BE AND END AND END EXPERSE IN BOX END EXPERSE IN BOX END EXPERSE IN BOX END EXPERSE IN BOX END EXPERSE IN BOX END EXPERSE IN BOX END EXPERSE IN BOX END EXPERSE IN BOX END EXPENSE IN	701				*	*	B	35110	12/2	111
100 als 370 10 36." CMP EXENT 68816 CEPLACE 36" CMP 10 EXLESS WITH 48" RCP PROP) WARD. 160 48" RCP PROP) WARD. WARD. WARDE TO SANTA ANA RIVER FROM OLNO GROUND									RIVER	
THE DAYS STO NO 36" CMP FERS) 688-66 BEFLACE BOTTON TO BREEFE TO BREATH THE WARE TO BREATH THE WARE TO BREATH THE WARE TO BE AND THE WARE TO BE AND THE WARE TO BE AND AND AND THE REPLACE TO BE AND THE BETTE TO BE AND AND AND AND AND AND AND AND AND AND		•								
THECHARGE TO SANTA ANA RIVER FROM OCHO GROUND	603	18			110		_	188160		1
THECHARGE TO SANTA ANA RIVER FROM OCNO GROUND						02/	\Box		V	
THECHARGE TO SANTA ANA RIVER FROM OUND GROUND))	
NECHARGE TO SANTA ANA RIVER FROM OCNO GROUND										
ANA RIVER FROM OCNO GROUND	104				260		48 RCP/Entle	26.180	REPLACE 48" RCP	NO EKCESS FLA
ANA RIVER FROM OCNO						260	60" RCP (PROP)		w174 60"RCP	1 1
ANA RIVER FROM OCNO								1		
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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

									PAGE MOF 39
8	T E	N IN	PERTINENT INFORMATION ON SIDE-	3		DRAMAGE INVESTIGATION - Z	Lower	SANTA ANA	RIVER
						LEFT BANK		1	
		SUBAREA	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
4	MAN	32 15	DISCHANGE PEAK C.F.S.	Q CFS	BOWDUAL 0 C.F.S.	DESCRIPTION	STATION	PERABRIS	DIRECTION OF EXCESS FLOW
501				5//	65	48" RCP W/ F.G.	695170	JOIN 6X167. PIPE (NETRY, DODITIONAL 49	NO EXCESS FLOW
24				38	38		01+289	101	No Exests From
101	11,	62.0	069	210	97	48" RCP W/ F.G.	4:699	JOIN EXIST PIPE	NO EXCESS ROW
801				180	زز	RCP	001659	JOIN EXIST PIPE	10881 FLOODING
baj				09	Q	(B"CMP	654.40	REPLACE 18° CAP WITH 36°CMP	PLATE UE NO EKCESS FLOW
011	o.L.	85'/	2060	7060	1500	(2) 12'x9' RCB	7.879	JOIN EXIST. BOX TIE BACK RIVER LEVEE TO BITTER- BUSH CHANNEL	LOEAL FLOODING 45 INO/CATED ON PLATE NE

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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

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	ATE E		PERTINENT INFORMATION ON SIDE-	3	SDE-DRA	DRAINAGE INVESTIGATION -	LOUER	SANTA ANA	RIVER
_ {						LEFT BANK			
		SUBAREA	EA	TOTAL		SIDE-DRAMAGE REQUIREMENTS			
MD	MA.	31 1E	DISCHARGE PE AK C.F. S.	o Cf.s	MDIVIDUAL Q C.F.S.	DESCRIPTION	STATION	NEWATHS	DIRPORTTON OF EXICESS FLOW
				١					
Z				1/2		48" RCP/EXIST 625+94		REPLACE 48" RCP	NO EXCESS FLOW
					02/	60"RCP (PROP)	1	WITH GO"RCP.	
7/1				670	5/0	18) 5/x 5' RCB	55+529	IOIN EXIST. BOX	IOCAL FLOODING
	7, 7	Ì				, ,		1	46 INDICATED ON
	7	95.0	1040						2N 31076
				,					
13				2/0	220	6) 2,x3, BCB	621110	JOIN EXIST BOXES	NO EXCESS FLOW
						/			
711				,		2000		į.	
†				45		* ZA" CDP (ENST)	6051/0	REPLACE 24" CHP	NO EXCESS FLOW
			,		3	48" CHP (PROP)		WITH 48"CHP	
*	FR	FREENAY		DRAINS	<i>(</i> 0				

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

SUBMER 122 (ALC) 1014 SIDE DAIME REQUIREMENTS 1. 2.61 2460 240 10 x 11 RCB 643+40 JOIN EXIST BOX CAPP 1010 1010 EXIST BOX LAP CAPP 1010 1010 EXIST BOX LAP CAPP 1010 1010 EXIST BIDES 1. 2.61 2460 240 10 x 11 RCB 643+40 JOIN EXIST BIDES 1. 2.61 2460 24 (2) 30° CMP 621410 1010 EXIST BIDES 2. 42 (2) 30° CMP 621410 1010 EXIST BIDES 2. 42 (2) 30° CMP 621410 1010 EXIST BIDES 2. 42 (2) 30° CMP 62 1010 EXIST BIDES 2. 42 (2) 30° CMP 62 1010 EXIST BIDES 2. 42 (2) 20° CMP 62 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 3. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EXIST BIDES 5. 80° CMP 1010 EX	### 312 STANDAN TOTAL STREETH	2	RTIME	NT IN	PERTINENT INFORMATION ON SIDE-	N ON N		DRAMAGE INVESTIGATION - 1	LOUER	SANTA ANA	RIVER	_
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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

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JOIN JOIN JOIN JOIN	PERTINENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION - LOUER SALTA ANA RIVER	INFORMATION	PERTIMENT IN
SUBMER A TOTAL SIDE-DRAMAGE REQUIREMENTS DISCUSSION OF SCRIPTION STATION C.F.S. C.F.S. C.F.S. C.F.C.P. GROTE JOHN UNW Q/I 2.80 (20 45 54 R.C.P. J.F.G. 583+26 JOHN 40 40 30" R.C.P. J.F.G. 583+26 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. A. BO" R.C.P. 553+36 JOHN A. B. B. B. B. B. B. B. B. B. B. B. B. B.			
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UW 211 280 100 36° RCP 600+30 10/10 120 145 59" RCP 4/F.G 583+26 10/10 40 40 30" RCP 583+36 10/10			
UW all 280 (120 45 54"KCP 4/F.G 583726 50 to 40 40 50° RCP 555 50° W	110 36º RCP 600+30		
120 145 54"RCP W/F.G 583724 DIN 40 40 30" RCP 583736 JOIN	1 1		//a//
40 40 20" 200 583+36 1011	145 54"RCP 4/F.G		2
40 40 30" RCP 583+36 10/11			
	40 30" RCP 583+30		w.
			-

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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

PAGE 81 OF 39	WER SANTA ANA RIVER			ATION OF ENCESS FLOW	4150 Join Exit P. PFS JARD! Elocoura	(NSTALL ADDITIONAL 45 IND.	36" RCP PLATE NE	П			6100 SANTIAGO CREEK IN ETCESS FIOW	CONFLUANCE STRUS							
PAGE				0 101100	/000/	46 IND.	Г	П			220	100							
	SANTA			REMARKS	F112 [10]	ł	36" 80.0			1	ŀ								
	Louer			STATION	508150						266 100								
	PERTMENT INFORMATION ON SIDE-DRAINAGE INVESTIGATION	LEFT BANK	SIDE-DRAMAGE REQUIREMENTS	DESCRIPTION		36" RCP (PROP)					_ 1	(SANTIAGO CREEK)							
	SIDE-DRA			SC. S.	0					L	2000								
	8		TOTAL	C.S.S	08/					,	2000								
	ORNATIO		AMEA	DISCHANGE PEAK C.F.S.	720						2000			 		_	 	 	
	1		3	\$1.2E	700	1					105.7								
	ATE			¥	1017	<u> </u>				1								 	
	2			1	3	12/				100	122								_

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

Γ		SIBAREA	2	7		A/GW/ BANK			
3 4	¥	3: ZE	DISCHARE PEAK C.F.S.	O C.S.	MDWDUAL O	DESCRIPTION	STATION	SERVICE STATES	DISTORATION OF EXCESS FLOW
27/			•	240	120	48"RCP (EXIST)	580+89	JOIN EXIST PIPE	NO EXCESS FLOW
	". "//"	0.07	320					40"RCP.	
121				80		20"CAP W/FG.	254.00	REPLACE 30" CHP WIH 48" CHP	NO EXGESS FLOW
								W F.G.	

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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

						İ					PAGE 550F 39
### 112	## 312 Sac Sac CAR Sacrama Station Station CARDON CARD		Tage		OPPRATIO	20 2		MAGE INVESTIGATION -	Lower	SANTA ANA	RIVER
1.12 October 101 October 101 1	1.12 Second Sec							RIGHT BANK	_		
WIN 034 690 (25 See 200 See 20	WAS 3128 ORGANISM (CES OF 20 36" CMP 556465 1010 EXIST FIPE 1020 1190 (MIS OIL 300 300 20 36" CMP 556465 1010 EXIST FIPE 1020 1190 (MIS OIL 300 300 20 36" CMP 556465 1010 EXIST FIPE 1020 1190 (MIS OIL 300 210 60" ECP 55646 1010 EXIST FIPE 10 556 555 FIPE 10 56655			-	E A	TOTAL		IDE-DRAMAGE REQUIREMENTS			
WY 031 300 300 10 56" CMP 586465 JOIN EXIST FIPE INDICATED ON WY 034 690 15 100 36" RCP W/F.G. 52844 JOIN EXIST FIPE WOLESSES F. WY 034 690 15 120 36" RCP W/F.G. 52844 JOIN EXIST FIPE WO EXCESS F. 40 210 60" RCP W/F.G. 49843 JOIN EXIST FIPE WO EXCESS F. 40 125 36" RCP W/F.G. 49843 JOIN EXIST FIPE WO EXCESS F.	4115 0.11 300 300 20 36" CMP 56016 1010 EXIST FIPE INDICATED ON PLATE AS 415 100 36" RCP N/KG. 62814 1010 EXIST FIPE WO EXCESS A 416 210 60" RCP 16" 10" EXIST FIPE WO EXCESS FIP 418 210 60" RCP 16" 10" EXIST FIPE WO EXCESS FIPE 419 210 60" RCP 16" 10" EXIST FIPE 410 210 60" RCP 18" 10" EXIST FIPE 410 115 36" RCP 16" 10" EXIST FIPE 410 115 36" RCP 18" 10" EXIST FIPE 410 115 36" RCP 18" 10" EXIST FIPE 410 115 36" RCP 18" 10" EXIST FIPE 410 115 36" RCP 18" 10" EXIST FIPE 410 EXCESS FIPE			3218	DISCHARE PEAK C.F.S.	0 5	3	DESCRIPTION	STATION	REMARKS	_
4115 0.11 300 300 10 36" CMP 566165 1010 Exist TIPE MADIEATED ON 410 15 100 36" RCP N/FG, 678140 1010 Exist FIPE WO Excess A 410 210 40 210 40" RCP [Exist] 50915 1010 Exist FIPE WO Excess F 410 210 400 210 40 Exception Matrix All PRESS F 410 210 40 115 RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 215 40 Exception Matrix All PRESS 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist FIPE NO Excess F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 Exist F 410 115 30" RCP N/FG, 498155 1010 RCP N/FG N/FG N/FG N/FG N/FG N/FG N/FG N/FG	"MIS OIL 300 300 10 36" CMP 560 1010 EXIST FIPE MAJORATED ON BUST BY BOOK ON BUST FIPE WOLLD ON BUST FIPE WO EXCESS A FILL ON EXIST FIPE WO EXCESS A FIRM ON EXIST FIPE WO EXCESS A FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIPE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRM ON EXIST FIRE WO EXCESS FIRE WO	_									
W 0.54 690 (15 120 36"RCF WKG. STRING JOIN EXIST PIPE NO EXCESS A STRING JOIN EXIST PIPE NO EXCESS A STRING JOIN EXIST PIPE NO EXCESS A STRING JOIN EXIST PIPE NO EXCESS PAGES (40 270 270 200 270 270 270 270 270 270 27	"W" 034 690 15 120 36" RCP W/KG, 678740 101N EXIST FIPE NO EXCESS A "W" 034 690 15 120 36" RCP W/KG, 678740 101N EXIST FIPE NO EXCESS F "TO GO" RCP [BITS] 54975 101N EXIST FIPE NO EXCESS F "TO GO" RCP [BITS] 54975 101N EXIST FIPE "YO [15 36" RCP W/KG, 498755 101N EXIST FIPE "YO FIEE SUPECT W/KG, 498755 101N EXIST FIPE "YO FIEE SUPECT W/KG, 498755 101N EXIST FIPE "YO FIEE SUPECT W/KG, 498755 101N EXIST FIPE "YO FIEE SUPERIOR FILE "YO		MVS	0.11	300	300	20	36" CMP	594989	JOIN EXIST PIPE	SW/
46 (10 36 RCP W/KG. STR46 JOIN EXIST PIPE NO EXCESS A 40 210 60 RCP 68167 JOIN EXIST PIPE NO EXCESS A 40 210 60 RCP 68167 JOIN EXIST PIPE NO EXCESS A 40 210 60 RCP 68167 JOIN EXIST PIPE NO EXCESS A 40 115 36 RCP W/F.G. 498155 JOIN EXIST PIPE NO EXCESS	450 (15 120 36" RCP W/FG. 628140 101N EXIST PIPE NO EXCESS A 450 210 40" RCP (PROP) 588185 101N EXIST PIPE NO EXCESS P 450 210 40" RCP (PROP) 66" RCP. PROVIDE ONG 40 185 36" RCP W/F.G. 498155 101N EXIST PIPE 40 185 36" RCP W/F.G. 498155 101N EXIST PIPE 40 185 36" RCP W/F.G. 498155 101N EXIST PIPE										
0.34 690 15 120 36"RCP W/FG. 52844 JOIN EXIST PIPE NO EXCESS A 450 210 40"RCP EXIST SOM EXIST PIPE NO EXCESS I 450 210 40"RCP EXIST SOM EXIST PIPE NO EXCESS I 450 210 40"RCP EXIST SOM EXIST PIPE NO EXCESS I 450 210 40"RCP W/FG. 49845 JOIN EXIST PIPE NO EXCESS I 450 185 36"RCP W/FG. 49845 JOIN EXIST PIPE NO EXCESS	## ast 640 15 120 36"RCP w/KG. 52846 JOIN EAIST PIPE NO EXCESS A ## ast 640 15 120 36"RCP w/KG. 52846 JOIN EAIST PIPE NO EXCESS A ## ast 640 210 40"RCP [EVINT] 549435 JOIN EAIST PIPE ## ast 66" RCP PROPERS JOIN EAIST PIPE ## ast 86" RCP W/F.G. 498135 JOIN EAIST PIPE ## ast 640 8 640 RCP PROPERS JOIN EAIST PIPE ## ast 640 RCP W/F.G. 498135 JOIN EAIST PIPE ## ast 640 RCP W/F.G. 4981										
460 15 120 36 RCP 57244 JOIN EXIST, PLPE NO EXCESS 460 210 60"RCP 64167 MSTAL ABOLTIONAL 460 210 60"RCP (PROP) MSTAL ABOLTIONAL 460 185 36 RCP JFG. 498455 JOIN EXIST PLPE NO EXCESS	#1 034 640, 15 120 36 RCP 52244 JOIN EXIST FIPE NO EXCESS. 460 210 60"RCP EXIST JOIN EXIST PIPE NO EXCESS P (40 210 60"RCP PROP) 66" RCP. PROVIDE ONG (40 225 36"RCP V/F.G. 498155 JOIN EXIST PIPE NO EXCESS.					8	00/	36"RCP W/F.G.	528+40	EXIST	Excess
460 (15 120 36" RCP 52244 JOIN EXIST, FIPE NO EXCESS 1 460 210 60" RCP [Brist] 509135 JOIN EXIST PIPE NO EXCESS 1 (10 210 60" RCP [Brist] 509135 JOIN EXIST PIPE NO EXCESS 1 (12 36" RCP N/F.G. 498135 JOIN EXIST PIPE NO EXCESS	450 25 120 36 RCP 57244 1014 EXIST, PIPE NO EXCESS 1 450 210 40" RCP [EVIST] 599135 1014 EXIST PIPE NO EXCESS P (40 210 40" RCP [PROP] 66" RCP. PROVIDE ONG (40 115 36" RCP 4) F.G. 498135 1014 EXIST PIPE NO EXCESS										
WY 0.34 690 15 120 36 RCP 582+40 JOIN EXIST FIPE NO EXCESS F 480 210 60"RCP [Exist] 509+35 JOIN EXIST FIPE NO EXCESS F 66" RCP. PROVIDE ONG 90 135 36" RCP JF.G. 498+35 JOIN EXIST FIPE NO EXCESS	480 210 400 EXECT 57744 JOIN EXIST PIPE NO EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEESS F. 40 EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXEEVE NO EXERTS FOR NO EXER		- 1								
480 210 GO"RCP[ENIST) SORTAL ADDITIONAL NO EXCESS F (120 GO"RCP[PROP] MSTALL ADDITIONAL NO EXCESS F (40 125 36"RCP W/F.G. 498155 JOIN EXIST PIPE NO EXCESS	450 210 60"RCP/EXIST 509+35 1010 EXIST PIPE NO EXCESS F (270 (26" RCP. PROVIDE OND (40 (25 36"RCP 4/F.G. 498+55 1010 EXIST 1119E NO EVEEKS		M	0.34	690	25	150	36 " RCP	25.74	JOIN EXIST, PIPE	Excess
480 210 60"RCP/EXIST JOIN EXIST PIPE NO EXCESS F INSTALL ADDITIONAL 66" RCP. PROVIDE ON' 90 125 36"RCP N/F.G. 498+35 JOIN EXIST DIPE NO EXCESS	460 210 60"RCP (PROP) INSTAUL ABOITIONAL NO EXCESS FOR CONTROL ABOITIONAL NO EXCESS FOR CONTROL ABOITIONAL NO EXCESS FOR CONTROL ABOITIONAL ABO	_									
110 Cal' RCP (PROP) INSTALL ABOITIONAL GEORGE CO. PROVIDE ON'S [15 36' RCP W/F.G. 498155 Join Exist PIPE NO EYEFTS	110 Cal' RCF (PROP) INSTALL ABOITIONAL 66" RCP. PROVIDE ONG 125 36" RCP N/F.G. 498155 Join Exist PIPE NO Every	_				480	012	60"RCP (6x16T)		EXIST	1
90 125 36" RCP W/F.G. 498+55 JOIN EXIST PIPE NO Breeks	40 125 36"RCP W/F.G. 498+35 Join Exist DIPE NO ETEESS	_					012	RCE		1 1	
40 125 36" RCP W/F.G. 498+55 JOIN EXIST PIPE NO Breeks	40 125 36 RCP W/F.G. 498155 JOIN EXIST PIPE NO BYEEKS									G6" RCP. PROVIDE ONG	
		_				90	581	1	28,86	EXIST	Ereek
								1 1			I I
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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

2	T NE	2 5	ORMATIO	3	20E-08A	PERTMENT INFORMATION ON SDE-DRAINAGE INVESTIGATION - 100 FR	Louek	SANTA ANA	PILEO
						LEFT AND			
		-	Y	TOTAL		SDE-DRAMAGE REGUNEMENTS			
4	I	3218	DISCHAREE PEAK C.F.B.	6.55	DEPENDENT Q C/S	DESCRIPTION	STATION	ACIMONIS	BOLLES OF ENGINE FLOW
138	188 1113	0.83	067/	0621	1600	(2) 10'x 5'. " RCB	592465	JOIN GAIST ROX	NO SKEESS FLOW
	4								
20	3	0.0	1/2	170	061	48"RCP	4000	JOIN GAIST PIPE	NO EXCESS FLOW
1									
1									

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

	TOTAL SDE-DRAMAGE INVESTIGATION - Loue & SANTA ANA RIVER Loue Lo		I								LACE SOCIETY
10 10 12 14 10 10 10 10 10 10 10	10 10 10 10 10 10 10 10	티		≧	ORMATIO	8			LOWER	ANA	RIVER
100 100 100 100 100 100 100 100 100 100	FOR TOTAL SOC-DAMME NEGLINES STATES RELIEBENTS OFFICIAL STATES OF 22							RIGHT BANK	•-		
90 90 12 50 2CP (EXIST) 399.70	10 10 12 24 RCP W.E.G. 552.46 JOIN EXIST PIPE NO 10.10 10 10 10 10 10 10 10 10 10 10 10 10 10 1	l		3	2	TOTAL		IDE-DRAINAGE NEGUNEMENTS			
90 90 22 50°ECP/EXIST) 39.70 101N EXIST PIPE NO. 10 48°ECP/EXIST) 39.70 ABS REST PIPE NO. (NO 110 12 14°ECP W/FG. 359.41 (01N EXIST PIPE NO. (NO 120 60°ECP W/FG. 359.44 (01N EXIST PIPE (010 PE)) (A) 200 60°ECP W/FG. 359.44 (01N EXIST PIPE (010 PE)) (A) 200 60°ECP W/FG. 359.44 (01N EXIST PIPE (010 PE)) (A) 200 60°ECP W/FG. 359.44 (01N EXIST PIPE (010 PE)) (A) 200 60°ECP W/FG. 359.44 (01N EXIST PIPE (010 PE))	90 90 22 2000 COLOR (1010) EXIGT PIPE 100 000 1000 1000 1000 1000 1000 1000	. .	*	31.26	DECHARE FEAK C.F.S.	6.3	MDWGUAL 0 C.S.	DESCRIPTION	STATION	S S S S S S S S S S S S S S S S S S S	BEFORTOR OF ENGINE FLOW
90 90 52 50° RCP [EXIST] 399.10 COIN EXIST PIPE NO 10 48° RCP [PROF] 48° RCF PIPE NO 10 10 12 24° RCP W/FG. 359.46 101N EXIST PIPE NO 10 10 60° RCP W/FG. 359.46 101N EXIST PIPE 1069 10 100 60° RCP W/FG. 359.46 101N EXIST PIPE 1069 10 100 60° RCP W/FG. 359.46 101N EXIST PIPE 1069 10 100 60° RCP W/FG. 359.46 101N EXIST PIPE 1069 10 100 60° RCP W/FG. 359.46 101N EXIST PIPE 1069	90 90 12 50° RCP (EKOP) 319.70 101N EXIST PIPE NO. 10 48° RCP (FROP) 48.70 AB RCF 10 110 12 44 RCP W/F.G. 35545 (01N EXIST PIPE NO. 10 12 40 RCP W/F.G. 35545 (01N EXIST PIPE (050) 10 10 10 40 RCP W/F.G. 35546 (01N EXIST PIPE (050) 10 10 10 10 10 10 10 10 10 10 10 10 10 1										
10 48° RCP (PROP) MSTALL ADDITIONAL MOSTALL ADDITIONAL MOSTALL ABOTTIONAL MOSTALL MOSTALL ABOTTIONAL MOSTALL ABOTTIONAL MOSTALL ABOTTIONAL MOSTALL ABOTTIONAL MOSTALL ABOTTIONAL MOSTALL ABOTTIONAL MOSTALL	10 10 12 48' RCP (PROP) MISTALL ADDITIONAL 10 10 10 10 10 10 10 10 10 10 10 10 10	• 3	3	0.03		90	22	30° DCP Exist	240.75		NO KNESS KIND
0.19 680 (1) 24 RCP W FG. 35546 (101.0 EXIST PIPS NP (FORCE 110.10) (10 (1) 24 RCP W FG. 35546 (101.0 EXIST PIPS NP (FORCE 110.10) (FX CESS FLOW) (10 (1) 24 RCP W FG. 35746 (101.0 EXIST PIPS 101.0 45.11)	0.39 580 110 12 14 12 14 12 14 15 16 16 18 18 18 18 18 18 18 18 18 18 18 18 18						20	48" RCP (PROP)	1	INSTALL APPLIFICABL	
0.29 SB316 SON EXIST FIPS NO. 35516 SON EXIST FIPS NO. 201. 201. 201. 201. 201. 201. 201. 201	0.39 580 110 12 14 RCP W F.G. 35946 101N EXIST PIPS NO 129 (FORCE MOIN) NO 139 580 1010 EXIST PIPE (CLO 196 196 1010 EXIST PIPE (CLO 196 196 1010) 105 1010 105 105									48* RCF	
0.29 589-46 1011 EXIST FIPS AVE 1011 EXIST FIPS AVE 1012 EXIST FIPS AVE 1012 EXIST FIPS AVE 1012 EXIST FIPS AVE 1012 EXIST FIPS AVE 1012 EXIST FIPS AVE 1012 EXIST FIPS AVE 1012 AVE 10	0.19 190 (1) 24*RCP W F.G. 35946 1010 EXIST PIPE NO 0.19 190 (FORCE HOLD) (10 10 10 10 10 10 10 10 10 10 10 10 10 1		_								
1.19 (10 (1) 24"RCP W F.G. 35946 (01N EXIST PIPE NO (FORCE MOIN) 470 (200 60" RCP W F.G. 35846 (01N EXIST SIPE (000) 95 M	0.19 610 10 10 14 RCP W F.G. 35946 101N EXIST PIPE NO 0.19 610 100 RCP W F.G. 35846 101N EXIST PIPE 1064										
1,39 580 (10 10 12) 14°RCP W, F.G. 35946 (01) EXIST PIPE NO NO (FORCE MOIN) (A) (A) (A) (A) (A) (A) (A) (A) (A) (A	0.39 6W (1) 24°RCP W F.G. 35346 1010 EXIST FIPS WE (FORCE MOIN) 4.10 1.00 60° RCP W F.G. 35746 1010 EXIST FIPE 1068 (FXCESS FLOW) 45.01	11									
0.29 680 (E) 44 RCP W FG. 35346 101N EXIST PIPS NO (FORCE HOLN) 470 100 60" RCP W FG. 35740 101N EXIST PIPE (1069 45 IN)	1.19 (10 (1) 24"RCP W FG. 35946 101N EXIST FIPS NO 1.19 (10 10 10 10 10 10 10 10 10 10 10 10 10 1										
0.39 580 (10 12) 24°RCP W/F.G. 35946 (01N EXIST PIPE NO NO NO 139 580 (50 00 NO NO NO NO NO NO NO NO NO NO NO NO NO	1.19 (10 (1) 44 RCP W/ R.G. 35946 (01) EXIST PIPE NO 1.19 (40 LOD 60" RCP W/ F.G. 358146 JOIN EXIST PIPE LOCA (EXCESS FLOW) PLAN										
0.39 580 (1) 44 RCP W FG. 35946 (01N EXIST PIPE NO 0.39 580 (FORCE M) FG. 35846 (01N EXIST PIPE LOCA 470 LOD 60" RCP W F.G. 35846 (01N EXIST PIPE LOCA (EXCESS FLOW) 96 11	1.19 (10 110 11) 14 RCP W FG. 35546 (01N EXIST PIPS NO 1.19 (100 60" RCP W FG. 358140 JOIN EXIST PIPE (0000 05.01)										
0.39 690 (10 14) 24 RCP W F.G. 35946 (01N EXIST PIPE 1000) 470 100 60* RCP W F.G. 36140 (01N EXIST PIPE 1000) 92511	139 590 (10 (1) 14 KCP W F.G. 35946 JOIN EXIST PIPE JOIG (FORCE MOIN) 470 200 60* KCP W F.G. 35740 JOIN EXIST PIPE LOCA (FXCESS FLOW) 45 IN					-					1
0.39 580 (FOR RCP W F.G. 357.40 (FX.CESS FLOW)	0.39 180 (470 100 800 800 100 100 100 100 100 100 10					9	0)/	WKCP WEG.	252460	EX167	- 1
470 LOD 60" RCP 4/ F.G. 358140 JOIN EXIST PIPE (EXCESS FLOW)	470 LOD 60" RCP 4/ F.G. 37216 JOIN EXIST PIPE (EXCESS FLOW)	4 3	*;	ı						(FORCE MOIN)	
100 60" RCP W/F.G. 382160 JOIN EXIST PIPE (EXCESS FLOW)	100 60" RCP W/ F.G. 38740 JOIN EXIST PIPE (EXCESS FLOW)	~		0.39							
100 604 RCP W/F.G. 38140 JOIN EXIST PIPE (EXCESS FLOW)	100 60* RCP W/FG. 3874 (EXCESS FLOW)										
(Excess Flow)	(Excess Flow)					470	20%	73	260.10	- 1	1000018
						2/2			2000	1.	DE WOLCOTED ON
										1	O 27 A M

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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

				,	RIGHT			
Ц	3	EA	TOTAL		IDE-DRAWGE REQUIESENTS			
	31 26	PECK FEAK C.F.S.	O. C.E.	C.F.	DESCRIPTION	STATION	REMARKS	DEPOSITION OF EXCESS FLOW
148			75	36	24 RCP W/ EG	708+10	101. EXIST 719E	WO EXCESS FLOW
)		1 Folle I		HAIN E	NG THE
3					105103		SUMP	7
ţ,	0.4	770	-					From whe AB DIVER
								THO TO TRUBBE CHONNEL
			77%	716	000000000000000000000000000000000000000	160.10	- 1	AND RIVERS ES
			}			77777	I EDOCA NOW	
					3 PUMPS X 150,000		(ADDITIONAL 2-56"	
					GOH ED)		WILL BE INSTALLED	
_								
145 XL	81.0	1240	1240	12.40	(4) - 42° RCP	801/6	JOIN EXIST PIPE	NO GALESS FLOW
					FARCEO MAINS		PRCG H	
							I C	
					7/0/		1	co,
					18 PUMPS X 150,000		17.	
					(49 405)			
_								

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TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

10 12 12 12 12 13 13 13 13					5		LEFT BANK	1000	אמא איואאפ	KIVOK
Mo		Ц	3		TOTAL		SDE-DRAMAGE REQUIREMENTS			
140	ğ ğ	S S	32 18	W			DESCRIPTION		PEMARKS	WAROSTION OF EXCESS FLOW
47 120	146				135	14%	424 1190	1 1	2	1 1
47					,			1 1	0	
48 613 0.49 530 100 \$ 490 RCP 114+55 DRAIN TO PROPOSED NO HOLDING POND NO HOLDING POND NO HOLDING POND NO HOLDING POND NO HOLDING POND NO HOLDING POND NO HOLDING POND NO HOLDING POND NO HOLDING POND NO HOLDING POND NO HOLDING POND	100				110	K	10000		5	11
148 Grs 0.49 550 100 # 42" RCP 114455 SRAIN TO PROPOSED NO 149 140 # 36" RCP 166145 DRAIN TO PROPOSED NO 150 85 # 30" RCP 18446 DRAIN TO PROPOSED NO 150 85 # 30" RCP 18446 DRAIN TO PROPOSED NO 150 150 150 150 150 150 150 150 150 150	})		76 AU	\perp	11	אם מאכמסף דנסט
48 6v3 0.47 530 100 # 4 42" RCP 14455 5RAIN TO PROPOSED NO 149 140 145 5RAIN TO PROPOSED NO 149 150 15										
40	148	6/3	0.4	530	00/		42" RCP	1.	1	•
40			·						111	111
49										
150 85 # 30° RCP 18480 5891N TO PROPOSED NO HOLDING POND	199				90	*	36" RCP	1 1	1 1	NO EXCESS FLOW
150 85 * 30° RCP 199+80 58AIN TO PROPOSED NO HOLDING POND										
150 85 # 30° RCP 159+80 58AIN TO PROPOSED NO HOLDING POND								+		
DNIGTOH	15.				85	*	30° RCP		DRAIN TO PROPOSED	4-4
	·									

TABLE 2 SPF LOCAL STORM PEAK DISCHARGES

F 37			B FLOW		Read						Real									
PAGE 39 OF	RIVER		BAPOSTEN S' ENCES FLOW		NO GREGIS FLOW						NO EXCESS	Ĺ								
	SANTA ANA		FEMANS		CONFLUANCE STRUCT	WITH GREENVIEW-	BANNING CHANNEL		•		GREEN VIEW-BRINKS	CHANNEL CONFLUANCE	STRUCTURE							
	Louer		STATION		152+90		ÿ				85100									
	DRAMAGE INVESTIGATION - Z	IDE-ORANASE REGUITEMENTS	DESCRIPTION		TRAP. CHANNEL						MUNNED-BANNED	CHANNEL INTO	SANTA AND RIVER	AT HAMILTON AV.		-				
)	C.S.		3000							9800	1							
	3	TOTAL	O C?S		3000						1	9500								
	PERTINENT INFORMATION ON SIDE-	ZZ.	DISCUSSION TO THE C.F. S.		3000						;	9500								
	MT 106	3	37 18		GV4 2.57							10.5								
	RTINE			" "	614								614	307	1	210				
	X		1		/9/							79/								